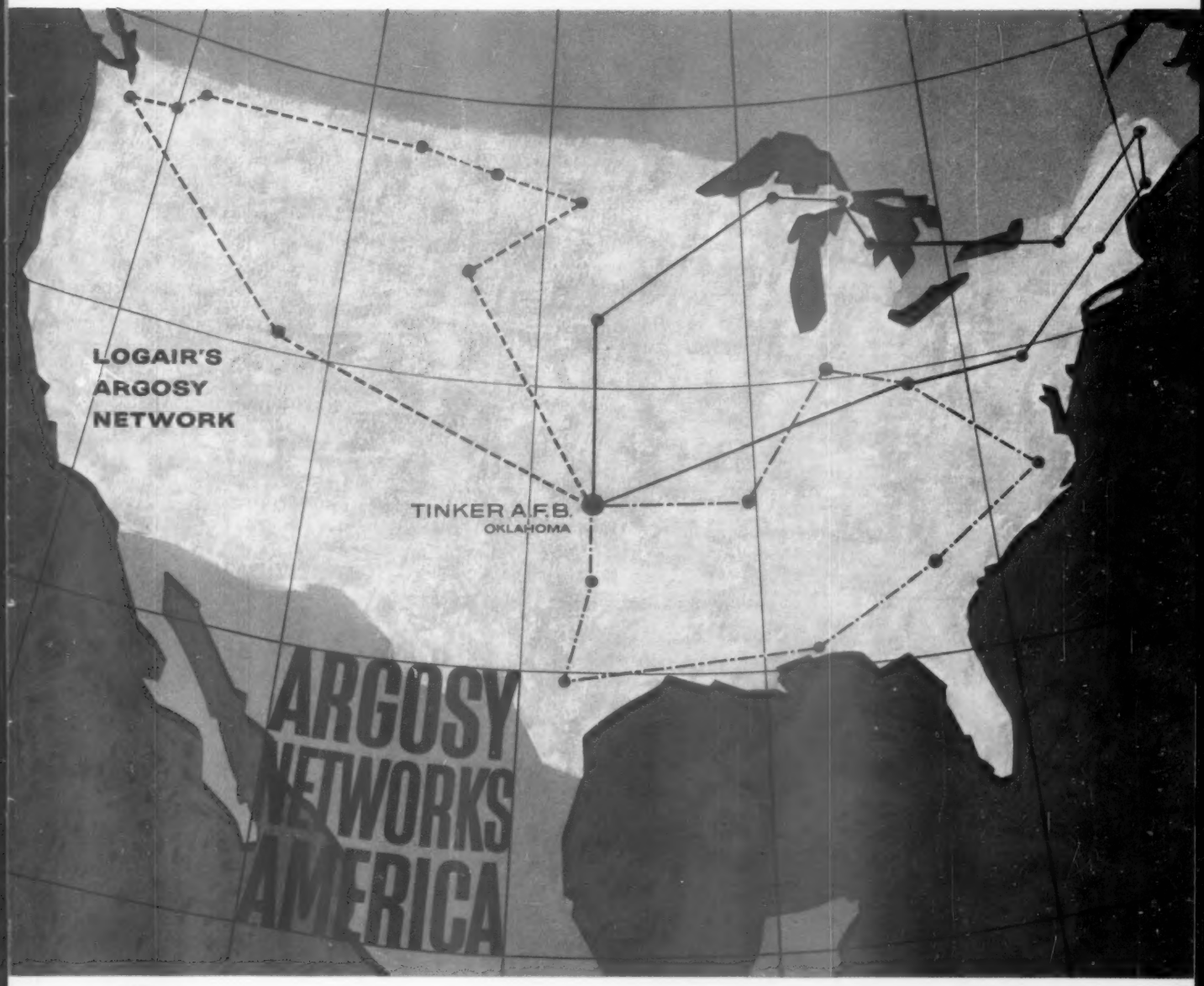
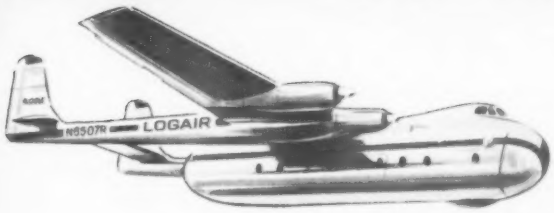
THE AEROPLANE and ASTRONAUTICS

DECEMBER 28, 1961

EVERY THURSDAY
ONE SHILLING
AND SIXPENCE





From coast to coast of the U.S.A., Riddle Airlines Inc. are flying Argosies up to 13 hours daily on U.S.A.F. Logair scheduled routes. No other aircraft can handle Logair's bulky cargoes with such speed and efficiency.

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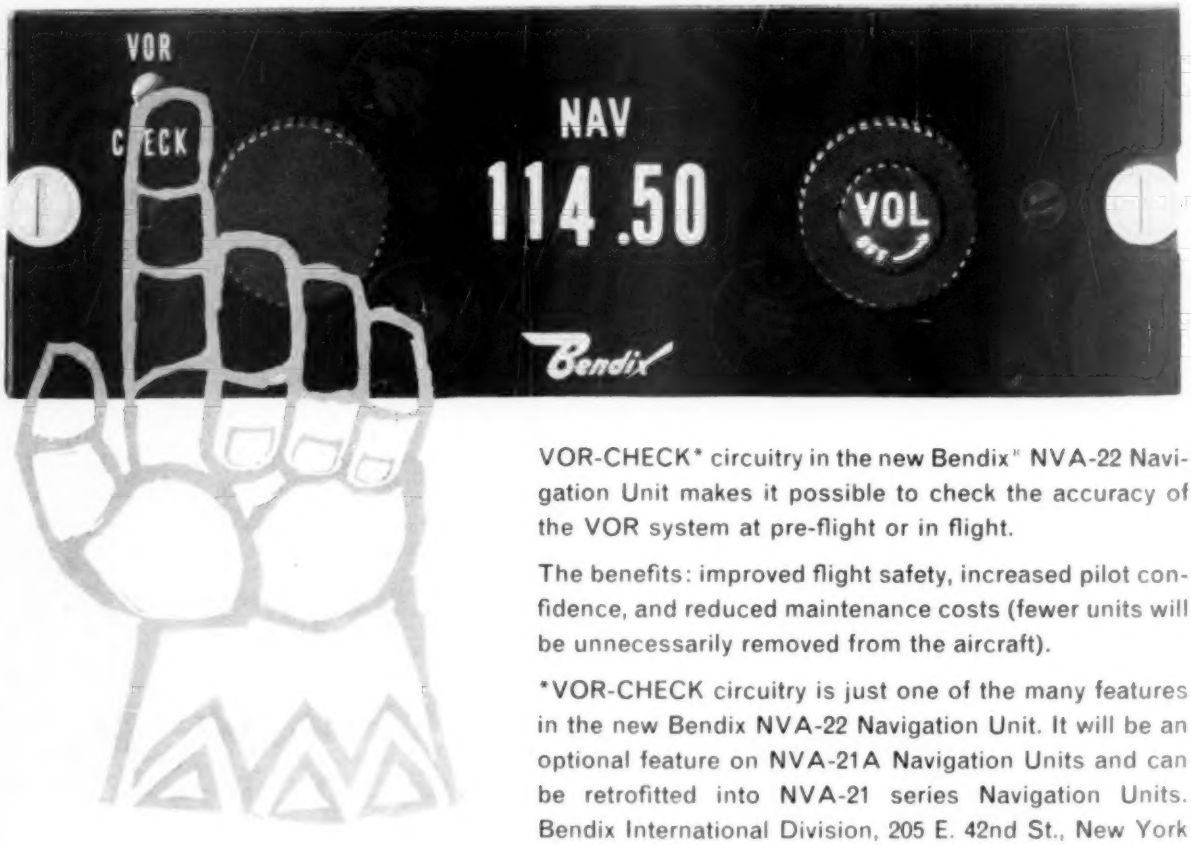

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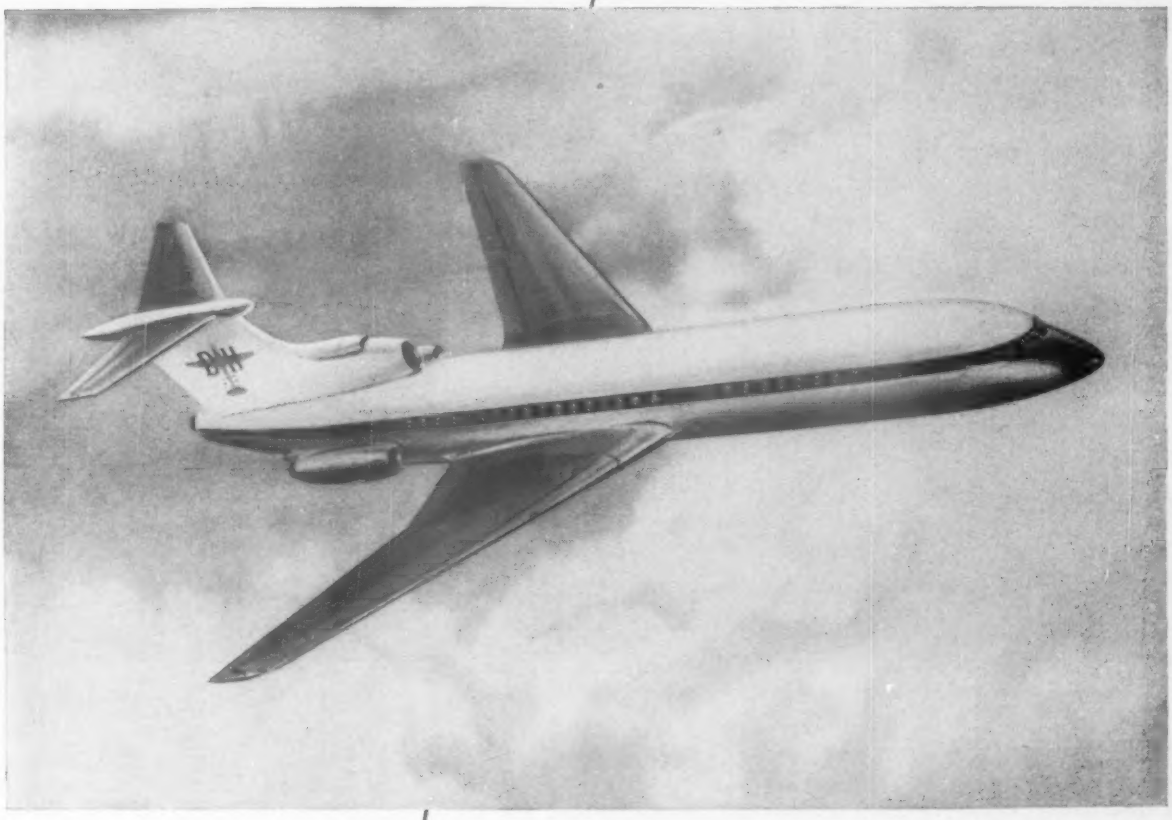

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A

PIPELINE IN THE SKY

Riddle Airlines Inc. are flying Argosies up to 13 hours daily on the U.S.A.F. Logair routes. Logair is one of the world's largest scheduled cargo operations — an aerial pipeline for the quick supply of urgent military equipment. From coast to coast these new Armstrong Whitworth aircraft speed outsize military loads in their capacious 47 ft. long holds, over a network of routes covering the U.S.A. Daily schedules bridge more than 12,000 miles.

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THE AEROPLANE and ASTRONAUTICS

VOLUME 101 NUMBER 2619 DECEMBER 28, 1961

The Year Behind Us

As 1961 draws to its close and one looks back on the year that is past, some problems that loomed large 12 months ago are seen to have solved themselves, others have proved recalcitrant and are still to be dealt with. No doubt plenty more problems will loom up in 1962.

But to offset unpleasantness there are pleasant surprises too. One in the past year has been the high level of exports. The latest figures indicate that up to the end of October the figures were running at the rate of £155 million per annum, not so far from the record figure for 1959. We must hope that the figures for November and December will be at the same high rate.

Writing at the beginning of the year we looked forward in an effort to discern the never-ending stream of successive events which as it passes the onlooker becomes time past. Those events, then so dimly outlined, have now taken place.

A year ago we were looking forward to definite decisions about the use of Blue Streak as a launcher. Those decisions have now been made and we can look forward to a triune space effort on the part of the U.K., France and Germany.

Progress with VTOL has not been as speedy as it might have been. Still two examples of the promising Hawker P.1127 have flown and a third is likely to do so soon. If only the right decision had been taken by our Government Departments involved in the year past, the Royal Air Force might have had some development versions flying operationally by the end of the new year. As it is, talk goes endlessly on while those who would profit by having actual hardware to experiment with can merely indulge in academic discussion.

Real progress has been made in manpowered flight. Thanks to the generosity of Mr. Henry Kremer two manpowered aircraft have been pedalled into the air.

At this time last year the kerosene/JP.4 fuel controversy was in the headlines thanks to Lord Brabazon's courageous stand. But it cannot be said that much progress has been made 12 months later in reducing the fire risk after heavy landing. Yet this must be more desirable than improving cruising speed.

One of the unexpected problems that has arisen in the past year has been widespread disappointment with airline results. Not only across the North Atlantic have far too many seats been chasing too few passengers. This sickness has become widespread. Raising load factors to an economic level must be the priority commitment of all airline managements for the year ahead.

On the other hand the British European Airways Corporation did make transport history by offering lower fares to Scotland than the railways. It is true that this was accompanied by some embarrassment in that it was made possible by an arrangement to carry mail and the mail loads proved much heavier than the experts anticipated. There have been occasions when mail competed with passengers for accommodation!

A fruitful sign of increasing business was the successful first flight of the twin-motor Beagle. It begins to look as if 1962 is going to see heartening expansion in the field of business aviation. Moreover, by the time this issue is published the Trident may well have made its first flight. Later in the year is to come the VC-10. Roll on 1962.

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Matters of Moment

Faireys to Come Back?

ANNOUNCEMENT that the Fairey Company had received an offer from the Bristol Aeroplane and Westland Aircraft Companies to acquire the issued capital of Faireys came as a surprise to the industry. The offer was in the form of a share-exchange basis. The terms proposed were two Bristol ordinary shares and two Westland ordinary shares for three ordinary Fairey shares.

It seems to be generally agreed that this is an equivalent to offering about 21s. 9d. for each Fairey share. Fairey shares had risen to 17s. 6d. just before the bid was announced.

Though it is general knowledge that too much factory floor space and too many people working on that space in the British aircraft industry are chasing far too few orders from the Government, it has been generally accepted that the member firms in the industry had settled down, with the exception of Handley Page at Cricklewood remaining outside the Groups.

The offer may not prove as attractive to shareholders as it seems at first sight seeing that the offer is on a "paper" basis. Though it might well involve an improved dividend, the net asset value of Fairey shares, excluding goodwill, is about 33s. per share. Moreover, an important proportion of Fairey assets are readily realizable.

By the time these words are read more information is likely to have been given by the Fairey Board, who have stated that after consultation with their advisers a statement will be made as soon as possible.

There is naturally much speculation about the reasons behind the bid. It might be that Westlands and the Bristol Aeroplane Company wished to acquire more productive space. In these days of diversification, such space might not be needed for building aircraft.

It is worth pointing out here that the Bristol Aeroplane Company has a 50% interest in Bristol Siddeley Engines and 50% in Bristol Aerojet, Ltd. It has a 15¼% interest in Short Bros. and Harland; a 20% interest in the British Aircraft Corporation and a 10% interest in Westland Aircraft, Ltd. It thus has holdings in much of the industry.

Westland Aircraft, as is well known, has acquired all the helicopter interests formerly belonging to Bristol Aircraft, Ltd., Fairey Aviation and Saunders-Roe, Ltd. In taking over the Fairey Company it would acquire overseas aircraft businesses. The most obvious of these is Avions Fairey at Gosselies in Belgium where an important NATO contract for F-104 fighters is now in production. Avions Fairey's agreements with various European firms are seen as giving Bristol and Westlands a useful way into the European market.

It has also been suggested that the Fairey interests in Australia and in Canada would be of special value to Westlands in view of the Navy's operation of so many Westland helicopters.

There is also the thriving business of Fairey Engineering in powered controls. Among Fairey's other interests are those in the field of nuclear power and in Siebe Gorman.

Fairey have done much work on the armament side with missiles and their very successful development of Fireflash will be recalled. Presumably the situation here is that it would be an embarrassment to the Government to order any missile, however successful, from a company now outside the aircraft industry. In this connection the Bristol Company's various links with the guided missile field might provide a useful way out.

Business Flying Boom

WHEN the accountants of such an official organization as the National Coal Board can be satisfied of the economic advantages of operating a company aeroplane, then clearly business flying in Britain is established. Last week's announcement of the acquisition of a D.H. Dove 8, for N.C.B. chairman Lord Robens and other Board members, puts the seal of approval on executive flying from an industry in which economics are particularly critical, and brings an important addition to the growing ranks of business aviation operators.

The Business Aircraft Users' Association now has nearly 70 member companies, drawn from all branches of general industry and commerce, and expansion is expected to continue steadily over the next few years. Prospects should, therefore, be good for the Beagle Group, which is continuing the development of a variety of light and executive aircraft, ranging from the single-engine four-seat Airedale (deliveries to start fairly soon) to the five/seven seat B.206 luxury twin.

The N.C.B. Dove is to be based at Luton Airport with McAlpine Aviation, Ltd., one of the biggest executive operators in Britain. This company operates six aircraft, of which two are leased to other companies on a long-term basis.

Contract for a "Super Saturn"

A CONTRACT to develop the first stage of the advanced Saturn launching vehicle, which will employ a cluster of Rocketdyne F-1 rocket engines of 1.5m.-lb. thrust, has been awarded to the Boeing company of Seattle. The order is worth more than $300 million and will keep Boeing busy at least until the end of 1966. The programme calls for the development, construction and testing of 24 flight boosters and several ground test vehicles.

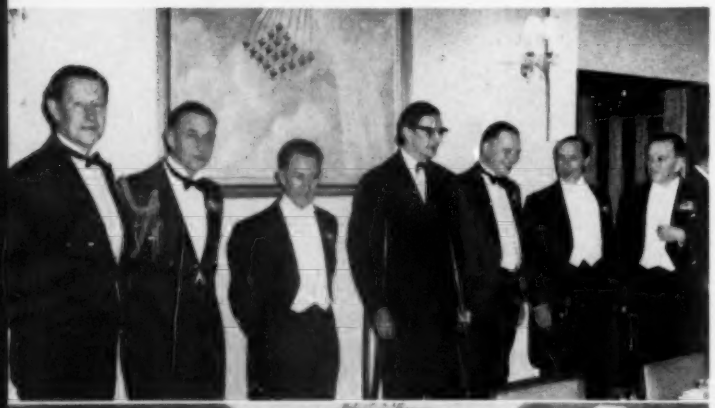
P.1127 Crash Cause

A STRUCTURAL failure of one of the swivelling jet nozzles of the Bristol Siddeley Pegasus powerplant appears to have been established as the cause of the Hawker P.1127 crash on December 14.

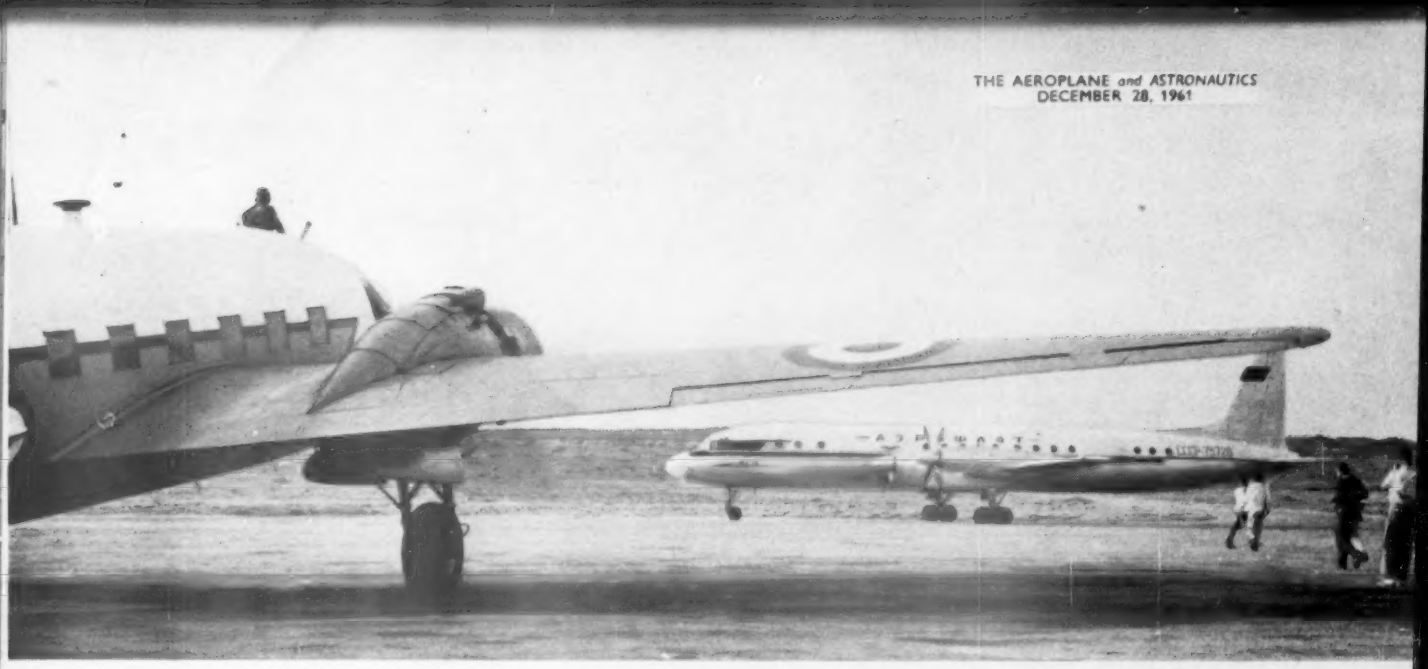
According to some official statements announcing this, the preliminary investigation has not revealed any fault in the airframe or in the internal functioning of the engine. This confirms our comment in the report of the accident published last week and suggests, too, that the failure was of the nozzle itself rather than its operating mechanism.

We understand that the failure was associated with one of the front nozzles; precisely how it failed has not been disclosed, but according to reports the complete nozzle became detached and was found some way away from the scene of the accident. These units being associated with the "cold" end of the engine and having to deal only with the relatively cool air from the outer portion of the turbofan are made of reinforced glass-fibre material. The rear nozzles, through which the exhaust effluxes are passed, are steel units.

Clearly, a major fault in any one of the four nozzles on the powerplant is likely to cause trouble because of the consequent loss of lateral thrust balance. This seems to be what happened when Mr. Bedford brought the crippled P.1127 down from 8,000 ft. on to a final emergency approach at Yeovilton. Having got to within a quarter of a mile of the runway at 200 ft., he found it necessary to motor in to avoid under-shooting. With power on, an out-of-balance thrust produced some rolling



STAFF COLLEGE CEREMONY.—The Chief of the Air Staff, Air Chief Marshal Sir Thomas Pike, unveiled a new portrait of H.M. the Queen at the R.A.F. Staff College, Bracknell, on Dec. 13. The ceremony also marked the first occasion that the College's new dining room (bottom) and lecture hall had been put to use. Top (l. to r.), Air Vice-Marshal M. L. Heath, Commandant, the C.A.S., Mr. A. C. Lovesay (who presented a picture of No. 111 Sqn. on behalf of Rolls-Royce), Mr. J. Yale, Sqn. Ldr. P. A. Latham, Mr. R. W. Harker and Sir Maurice Dean.



PROVIDENTIAL PARTNERSHIP.—Flood relief to Somalia has continued without pause since it began in mid-November. Here an R.A.F. Valetta of No. 233 Squadron starting out on a food-dropping mission, waits for a Russian Il-18, carrying a medical team, to complete its landing.

moments that were quite unacceptable in such conditions and he had no option but to use his ejector seat.

Fortunately, as the cause of the accident has been so clearly pin-pointed, the set-back to the P.1127 flight-test programme is not so serious as was first thought. The aircraft which crashed had been engaged solely on the high speed part of the programme and would have needed a fair amount of work on it in order to bring it to the standard necessary for it to take part in the hovering tests. When the third prototype becomes available in the near future, the programme will be able to go ahead as originally planned.

Last week, Hawker Siddeley Aviation had a Press showing of a 20-minute film concerning their products. Despite the attraction of some of the superb air-to-air shots in it, the "star" of the film was undoubtedly the P.1127 which was briefly seen making its early tethered VTOL tests. By way of a "bonus," however, the audience was also shown a two-minute sequence from a much later film record of the P.1127 flights.

Even though one has been, so to speak, conditioned to accepting the special capabilities of the flat-rising type of VTOL aircraft, there is no doubt that to see the P.1127 in action—even in a film—is something of an eye-opener. Its stability during hovering, and when making extremely slow movements in all directions close to the ground, is extraordinarily good. Indeed, it was surprising to learn afterwards that when this particular piece of the film had been made, there was a strong gusting cross-wind. Another outstanding impression from this brief glimpse of a most remarkable aeroplane is its very smooth transition from vertical to horizontal flight and its steady acceleration and deceleration out of and into the VTOL regime.

Aircrew Radiation Hazards

IN the latest issue of IFALPA's monthly newsletter some significant figures are given of high-altitude radiation levels following the recent Russian nuclear explosions. The levels proved, as expected, to be several times greater at high altitude than at ground level.

The highest single geiger-counter reading was 1.1 milliroentgen per hour, recorded at 35,000 ft. over a period of 10 minutes in the early morning of Nov. 5. The readings were taken on trans-Polar turbojet flights between Oct. 27 and Nov. 8. A 30-megaton device is thought to have been exploded over northern Russia on Oct. 23 and a 50-megaton device on Oct. 30.

The tests were made by airline pilots using the Polar route from Northern Europe to Tokyo, at altitudes between 25,000 ft. and 41,000 ft. and at irregular intervals as workload permitted. These circumstances, the newsletter comments, prevented any statistically reliable generalization to be made from the results, but the checks were none-the-less considered to be of value.

The Federation's programme of radiation monitoring on air routes began after the first Sahara nuclear test, when two sets of geiger-counter readings were obtained in an aircraft flying between Tripoli and Kano—the first five hours and the second 20 hours after peak intensity was to be expected. These readings were submitted to the (United Kingdom) Radiological Protection Service and the captain of the aircraft visited the Service's headquarters for a personal examination. He was found to have been unaffected and the readings, while high, were not considered to indicate that the danger limit had been reached by crew or passengers.

The newsletter explains that the highest reading on the Polar route, 1.1 mr./hr., is lower than the highest readings after the Saharan explosion—which were 3.0 mr./hr. for less than five minutes on the first flight and 2.0 mr./hr. for less than 10 minutes on the second flight. The flights on which readings were taken after the recent explosions were, however, irregularly spaced (Oct. 27 and Nov. 1, 4 and 8) and the highest reading was taken five days after the 50-megaton explosion and 11 days after the smaller explosion. It cannot, therefore, be assumed that the aircraft concerned passed through the most heavily contaminated air mass.

The general level of the readings following the Russian tests tended to be equal to, or higher than, the higher of the two earlier sets of readings—but not higher than the dose rate expected by the Radiological Protection Service at 50,000 ft. at latitudes of 50° N. In the words used by that Service, the newsletter continues, "a pilot could spend 60 hours a week at that altitude and latitude (or a higher latitude) without receiving a dose in excess of that recommended by the International Commission on Radiological Protection as being permissible to workers who are not regarded as being occupationally exposed."

While this comment will be found reassuring, the report concludes, the behaviour of contaminated air masses is still predictable only in the most general sense, "and it would seem advisable for Member Associations to continue to be prepared to monitor the results of future nuclear explosions, should they occur."

Martin-Baker Progress

A RECENT emergency ejection with a Martin-Baker seat marked the 500th successful escape with this aid, and a corresponding number of lives saved. This month will also end the first year in which over 100 lives have been saved with Martin-Baker seats, and reflects the increase in the number in service, gained to a large extent by the several thousand already delivered to the U.S. Navy and Marine Corps.

Pilots from these two Services were involved in approximately 50% of the total of ejections during 1961, bringing the number of American Service personnel who have been saved with the Martin-Baker Mk. 5 seat to more than 80. One of the latest escapes was the spectacular ejection from a disabled Chance Vought Crusader on the flight deck of a U.S.N. carrier at an extremely low speed, followed by successful deployment of the pilot's parachute just before entering the water.

After the first live test ejection in Great Britain by Benny Lynch on July 24, 1946, some three years elapsed before a Martin-Baker seat was used in an emergency. During the following 12 years, about 39 nations have adopted Martin-Baker seats, which have been used from 56,000 ft. down to ground level, and even below the surface of the sea; and from Mach 1.7 at 40,000 ft. down to virtually zero at ground level after aircraft impact. These British seats are now saving, on the average, two lives a week, and the successful development of rocket assistance has increased their value still further.

Aviation News in General

M.o.A. VISCOUNTS.—As briefly noted in our report of the E.T.P.S. McKenna Dinner last week, the School is to receive two Vickers Viscount 700 Series turbo-prop transports early in the New Year. One Type 744 and one Type 745, both ex-Capital Airlines, they will operate with the Empire Test Pilots' School at Farnborough, in evaluation and training rôles.

BOOM RESEARCH. — About 50 supersonic flights have been made by a B-58, F-104 and F-106 in a joint U.S.A.F./F.A.A./NASA study of shock wave effects on the ground and in the air. Tests included a study of the effect of sonic booms on two aircraft passing each other at high altitude.

VALKYRIE FINANCE.—For continuing work on the development of the three prototype B-70 Valkyrie Mach 3 bombers, North American has been allotted $52 million in the 1962 fiscal year budget by the U.S.A.F. The company has now received a total of $267.5 million for work on this aircraft.

PARIS ORDER.—Nine examples of the Morane Saulnier Paris II four-seat liaison jet have been ordered by the French Government. Total orders for the Paris I and II are now 144, of which 91 are export.

MORE SEA KINGS.—Sikorsky Aircraft division of United Aircraft Corp. has been awarded a $24,555,510 contract by the U.S. Navy for continued production of the HSS-2 Sea King.

UNITED ORDER.—A U.S.A.F. contract worth $14,157,990 has been placed with the Pratt & Whitney division of United Aircraft Corp. for TF33 turbofan engines.

DEFLATED.—U.S. Navy plans for an inflated VTOL aircraft have been dropped because "technical feasibility alone does not necessarily justify military development," says Navy Secretary J. B. Conally.

HONG KONG DEVELOPMENTS.—The Hong Kong Aircraft Engineering Company has now moved the major part of its activities to a new four-floor, 23,000-sq.-ft. building at Kai Tak Airport. This move is part of the company's redevelopment programme and of the overall Kai Tak development programme. Work has now started on the construction of a new office-stores-workshop building for the airlines at Hong Kong.

IRON CURTAIN EXECUTIVE.—During a business tour of European countries the Dove 8 owned by J. C. Bamford (Excavators), Ltd., landed at Warsaw making what is believed to be the first visit to Poland or any Eastern European country by a business executive aircraft. The aircraft—it has flown some 55,000 miles in its first 12 months of operation—arrived back on Dec. 20.

JETSTAR JAUNT.—A Lockheed C-140 JetStar has flown the 2,660 miles from Ontario, California, to Boston non-stop in 4 hr. 30 min., an average ground speed of 591 m.p.h.

GAPAN DINNER.—Fourth Livery dinner of the Guild of Air Pilots and Air Navigators will be on Wednesday, Jan. 10, 1962, at the Innholders' Hall, College St., London, E.C.4, at 19.45 hrs.

THIRD X-15.—First flight of the third X-15 research aircraft, damaged on the ground by an explosion in the propellent system on June 8, 1960, is expected as we close for Press. Rebuilt by North American Aviation, and never previously flown, it is now equipped with a newly designed Minneapolis-Honeywell adaptive control system.

RECCE JET.—New nose contours of Mirage IIIR, variant for photographic reconnaissance, are seen in this first photograph. Two prototypes are flying and a production order has been placed.

MORE HAWKEYES. — Grumman has received a $67,907,436 order from the U.S. Navy for additional W2F-1 aircraft.

LUNIK III REAPPEARS. — An "unidentified" satellite pursuing a retrograde eccentric orbit is now believed by U.S. tracking authorities to be the Soviet Lunik III probe which photographed the far side of the Moon in October, 1959. It was thought to have re-entered the Earth's atmosphere in April, 1960.

MONKEY LOSS.—After launching a 6 lb. monkey named Scatback a distance of 6,000 miles into the South Atlantic aboard an Atlas E ICBM from Cape Canaveral on Dec. 19, the search for the "pick-a-back" recovery capsule was abandoned by the U.S. Air Force. The capsule was believed to have sunk in rough seas.

ITALIAN BALLISTICS.—The Vitroselenia company of Rome has been awarded a £5.3m. contract for the design and installation of a missile testing range in Sardinia.

PERFECT ZEUS.—The seventh successful test of a Nike-Zeus anti-missile missile from Point Mugu, Calif., was conducted on Dec. 14. According to the U.S. Army, "the missile and command ground guidance equipment worked perfectly at extended range."

MOON BOUNCE.—The U.S. communications research ship "Oxford" on Dec. 17 picked up two radio messages bounced off the Moon while at sea between New York and Norfolk, Virginia. The messages were sent from a 60 ft. aerial at Stump Neck, Md., and received on the ship's 16 ft. aerial. It was the first time that a ship had received messages via the Moon.

MISSILE DESIGNATION. — Prefix letters are being added to U.S.A.F. missile designations to indicate the type of launching base. Examples are HSM-65 for an Atlas from a hardened silo and CSM-65 for an Atlas from a "coffin" launch complex.

(More news on pages 821-822)

ATLANTIC SECTION.—As recorded on the opposite page, Fokker is manufacturing the wing centre section and Tyne nacelles for the NATO Breguet Atlantic maritime patrol aircraft. Here the sub-assembly is being loaded on to a transporter at Schiphol for its journey to Toulouse.

Military Projects at Schiphol

A NEW nine-storey extension to the Fokker plant at Schiphol was officially opened by the Netherlands Minister of Defence on Dec. 18. Incorporating a complete electronics test centre, which represents a substantial increase in the company's activities in that field, the building has been constructed as part of the factory's expansion for the European F-104G Super Starfighter production programme.

Although Fokker is not manufacturing any of the electronic equipment for this co-operative fighter, the company is the main contractor of the North Group (comprising the West German concerns of Hamburger, Weser and Focke-Wulf and the Netherlands companies of Fokker and Aviolanda) and is therefore responsible for checking the "black boxes" on receipt from electronics companies engaged in the F-104G programme. Fokker is also installing and calibrating the equipment during assembly of the aircraft at Schiphol and keeping the units serviceable during the flight test and delivery phases.

Built on a foundation of 121 piles, the first of which was driven into the ground on Dec. 22, 1960, the test centre was first occupied on Nov. 1. It is now being equipped with the necessary test and calibration gear for checking the navigation, communication and fire-control units in the F-104G. At the present time there are 42 Fokker electronics engineers and 13 specialists representing the electronics suppliers at work there.

To maintain a high standard of cleanliness some of the laboratories in the centre are slightly pressurized to prevent dust from entering. Sixty yards away to the south side of the building, opposite a ninth-floor test laboratory, there is a radar echo simulator mounted on a wooden tower. On the floor immediately below the radar test laboratory there is a radome bore-sighting range, used for testing the F-104G nose radome to be manufactured by Fokker's subsidiary company Avio-Diepen.

The electronic programme for the European F-104Gs is spread over four countries—Germany, the Netherlands, Belgium and Italy—plus American manufacturers who are supplying 80 of the 949 sets of black boxes. The fighter's Litton inertial navigation system is to be produced by Litton GmbH, Monroe N.V. and Bell Telephone Manufacturing; its NASARR navigation and fire-control system is coming from Telefunken GmbH, Hollandse Signaalapparaten, Manufacture Belge de Lampes et de Matériel Electronique, and Fabbrica Italiana Apparecchi Radio; Standard Elektrik Lorenz and Face-Standart S.p.A. are manufacturing the Tacan system.

Other components in the overall navigation and fire-control system include a flight director, position and homing indicator, flight-data computer, bombing computer, infra-red homing equipment, radio and IFF units, and optical equipment.

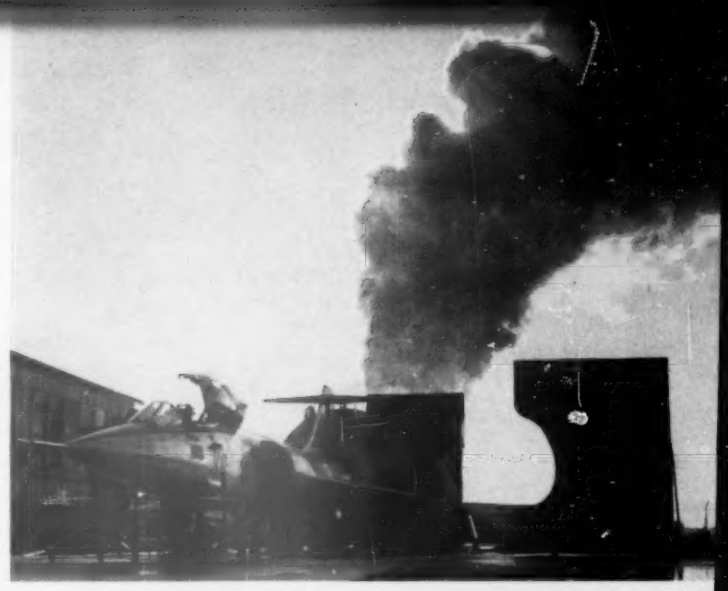
The heart of the all-weather multi-mission capabilities of the F-104G is the NASARR F-15A radar system developed by the Autonetics Division of North American Aviation. This operates in both the air-to-ground and air-to-air modes. In the former mode it provides ground mapping for all-weather bombing and navigation; contour mapping for navigation and terrain clearance; and range information for visual ground attack. With the fire-control computer in the air-to-air mode, the system gives radar search, acquisition and automatic tracking for collision-course attack with GAR-8 Sidewinder missiles, pursuit attack with the fighter's 20 mm. M-61 Vulcan cannon, or pursuit attack with 2.75 in. folding fin unguided rockets.

Four types of bomb attacks, including toss-bombing and over-the-shoulder bombing, are possible with the bombing computer, which is supplied with appropriate inputs from the flight-data computer. Navigational information provided by the Litton inertial system is automatically presented to the pilot on the position and homing indicator, and provision is made for a ground-to-air data-link system.

F-104G and Atlantic Production

As already recorded in a previous issue, the first F-104G to be assembled by Fokker made its maiden flight in the hands of chief test pilot "Jas" Moll on Nov. 11. Destined, as are the first 30 F-104Gs, to be produced by the North Group for the West German Air Force, it is due to be delivered in February.

The first five aircraft are being constructed from major assemblies supplied by Lockheed and the next 25 will be assembled from imported components manufactured by Lockheed and Canadair. Thus the 31st fighter off the final assembly line will be the first to be made wholly in Europe. Due to be completed by October, 1962, this aircraft will also be the first F-104G for the Royal Netherlands Air Force.



Actual fabrication of components by the European companies has now started. Forward fuselages from Hamburger, and central fuselages from Weser incorporating air intakes from Focke-Wulf, have begun to reach the fuselage assembly line at Aviolanda's Papendrecht factory. The remainder of the airframe—wings, tip tanks, tail surfaces and rear fuselage sections—is being constructed by Fokker, the work being divided between Schiphol and Dordrecht.

Altogether, a total of 325 F-104Gs are definitely planned to be assembled by Fokker, but this number may be increased by a further 25 aircraft at a later date. By far the largest contribution of the four regional groups engaged in the European programme, these aircraft will be powered by 15,800-lb. s.t. General Electric J79s assembled and constructed by the B.M.W. concern in Germany and Fabrique Nationale in Belgium.

In addition to its F-104G work, Fokker is participating in the manufacture of the Breguet Atlantic, the first wholly co-operative aircraft design and production programme in Europe (see THE AEROPLANE AND ASTRONAUTICS for Nov. 9, 1961).

For this NATO maritime reconnaissance aircraft the Dutch company has designed and is building the wing centre-section and nacelles for its two Rolls-Royce Tyne turboprops. The company has also made available to the other manufacturers engaged in the Atlantic programme its extensive experience in metal bonding, acquired in several years of F-27 Friendship production.

Fokker/Republic VTOL Project

The background to the development of the Fokker/Republic D.24 Alliance VTOL supersonic fighter-bomber project was given in our issue of Nov. 30 this year. To be submitted to the NATO competition for a VTOL strike aircraft to the BMR-3 specification on Jan. 10, 1962, this project incorporates variable geometry, or polymorphous, wing design and is a complete weapons system with fully integrated electronics for all-weather operation.

To be powered by one 36,000-37,000-lb. s.t. Bristol Siddeley BS.100 lift/thrust turbojet, the Alliance will have an all-up weight of approximately 32,000 lb. Its maximum speed will range from Mach 1.2 at sea level to Mach 2.2 at altitude (about 60,000 ft.). The weapons system is based on the Republic F-105 Thunderchief and incorporates infra-red and radar target detection, and photographic reconnaissance functions. As in the F-105, an immediate photographic processing system will provide the pilot with prints in flight.

A model of the Alliance was to have been exhibited by Fokker at this year's Paris Show, but was withdrawn at the last moment on security grounds. In its high-speed configuration it is understood that it will have a narrow delta wing, with a leading-edge sweep of approximately 65°. The leading edges will house auxiliary wings hinged at the fuselage so that they can be spread forward for vertical or short take-off and landing. Hydraulically operated, they will form a conventional wing with its own aileron system.

A computer-controlled full jet stabilization system will be used for VTOL operation and, as mentioned above, at low forward speeds it will have conventional ailerons. The high-speed delta-wing elevons, hinged on the fixed trailing edge, will act as elevators.

Air Transport

B.E.A. in October

TABULATED below are the traffic results of B.E.A. in October. They show a massive increase in capacity with the continuing introduction of Vanguards, which far outmatched the quite reasonable traffic growth of 14.7%. The revenue load factor fell in consequence by nearly seven points. Another disturbing feature of the month's results was the decline in freight traffic.

TRAFFIC RESULTS—OCTOBER, 1961

	October 1961	October 1960	Variation
Capacity ton-miles offered ..	24,937,000	19,428,000	+28.4%
Load ton-miles sold	14,410,000	12,558,000	+14.7%
Revenue load factor	57.8%	64.6%	−10.5%
Passengers carried	349,720	310,278	+12.7%
Passenger miles flown	126,868,000	108,056,000	+17.4%
Passenger load factor	56.2%	63.9%	−12.1%
Freight ton-miles	1,613,900	1,624,700	− 0.7%
Mail ton-miles	330,800	338,600	− 2.3%
Aircraft miles flown	3,443,700	3,234,600	+ 6.5%
Revenue hours flown	15,289	15,691	− 2.6%

An interesting indication of the higher average speed of the B.E.A. fleet is given by a small reduction in the number of revenue hours flown, despite the greater number of aircraft miles.

B.O.A.C. Steps up Comet Hours

AN annual utilization rate of 4,000 hours a year is planned for B.O.A.C.'s Comets in 1962. The Comets are already producing about 3,700 hours a year each, and the increased utilization will be achieved primarily by a revision of maintenance procedures.

The present Check III is to be eliminated and the work normally carried out at this time will be spread over seven of the more frequent Check IIs. By deploying more labour on Check IIs, the time on the ground will be kept to its present level. As a result, it is expected that the number of aircraft undergoing a Check I, II/III or IV at any one time will be reduced from four to three or, looked at in another way, the effective Comet fleet will be increased by one aircraft.

At least 5,000 extra Comet hours a year will be generated in this way. On African routes, the Comet has an earning potential of about £500 an hour, so the increased utilization could represent extra revenue of £2,500,000.

Friendship Progress in 1961

DURING the past 12 months the total order book for F.27 Friendships has risen to 207—120 of these being sold by Fokker and 87 by Fairchild. Together, these 207 transports (of which 165 have been delivered to date) represent between £60 and £70 million.

Up to the beginning of this month a total of 425,500 hr. had been logged by Friendships during 1961 and the maximum number of landings by a single aircraft (excluding U.S. operators) had risen to 6,835. An average load factor of 67.5% —the highest being 74% and the lowest 56%—was achieved during 1961 by non-American operators and an average daily utilization of 5.95 hr. The highest utilization was 9.8 hr. per day by Mac.Robertson Miller Airlines, and the lowest was 3.6 hr. An average direct operating cost figure of £64 per hour was recorded, the highest figure being £91.4 and the lowest £42.2.

Operational developments during the year included increases in all-up weight for RDa.6-powered versions to up to 39,000 lb. and for RDa.7-powered Friendships to 42,000 lb. (from 37,500 lb. in both cases). Effort is now being made to obtain approval for a higher permissible cabin pressure differential. By raising the differential from 4.16 lb./sq. in. to 5.4 lb./sq. in. it is possible to cruise at 25,000 ft. with a cabin pressure equivalent of 8,000 ft. This increase in cruising altitude will offer economic benefits to operators of the Friendship over the longer stage lengths.

Crisis Year for the Independents

A COMPULSORY winding-up order was made against Air Safaris, Ltd., on Dec. 18. In High Court proceedings, the company was described as "insolvent as it could be." Creditors supporting the petition, which was brought by Alkit, Ltd., included Esso Petroleum, Ltd., for £105,000, and five others for £5,050.

Air Safaris thus becomes one of six independent British operators which have either gone out of business or have run into financial difficulty during 1961. The others are Overseas Aviation (C.I.), which was compulsorily wound-up by order of the High Court on Oct. 9; Falcon Airways, which suspended operations and had its air operator's certificate withdrawn on Sept. 21; Pegasus Airlines, which ceased operations at the end of October; Tradair, which is continuing operations at a reduced level after the appointment of a receiver by Barclays Bank at the beginning of November; and B.K.S. Air Transport, which has also been in the hands of joint receiver-managers since November.

This thinning of the ranks—for which the provisions of the Civil Aviation (Licensing) Act, 1960, have been in large measure responsible—leaves well over 20 independent companies actively engaged in transport operations in the U.K. A list of these companies having air operators' certificates was published in our issue for Nov. 16 on page 644. Since that time, Caledonian Airways (Prestwick) has been certificated and has begun operations.

Despite the events of 1961—and of the latter half of 1960, when three other independents (Air Condor, Continental and Orion) went out of business and Don Everall merged with Air Safaris—new companies continue to appear. Reference has already been made in our pages to Black Isle Air Services, which has applied to operate on Scottish routes including some of those which B.E.A. finds unprofitable. Another newcomer with an outstanding application for a scheduled service before the

MIXED FRIENDSHIP.—Recently delivered to the West German charter company Lufttransport Unternehmen, this Fokker F-27 is a Series 300 mixed passenger-freighter with large forward freight door. This door will be a standard feature of the "long Friendship," which will have a 4-ft. 11-in. fuselage "stretch."

FRENCH FEEDER.—Posed over the French Alps, the Potez 840 turboprop airliner (four 530 h.p. Astazou turboprop engines) is shown to advantage in this new study. Plans have been completed for its sale in the U.S. market, particularly for business flying.

A.T.L.B. is Bournemouth Air Taxi, registered on Nov. 8. Last week we noted the formation of Euravia (London), Ltd., which plans to begin operations next March with three Constellations. A company called North Star Air Lines was registered in London on Oct. 4.

None of these airlines—nor any of the older-established ones for that matter—is likely to obtain an Air Service Licence until the A.T.L.B. is satisfied about its financial resources. Although the Board has not made a point of announcing its approval of airlines in this respect, the issue of E-class licences is a useful indicator. An E-class licence allows certain types of operation without restriction as to origin or destination, and the Board, in fact, has not issued any such licences until the investigation of the airline under the terms of Section 2 (2) (a) has been satisfactorily completed.

Those companies which have been granted "E" licences to date are B.E.A., B.O.A.C., B.U.A. (Services), Caledonian Airways (Prestwick), Channel Air Bridge, Cunard Eagle Airways, Dan-Air Services, Eagle Aviation, East Anglian Flying Services (Channel Airways), Manx Airlines, Morton Air Services, Silver City Airways and World Wide Aviation. Others are likely to be added to this list in the near future.

U.K. Accident Survey for 1960

NO passengers were killed during 1960 in accidents involving British-registered aircraft on scheduled or non-scheduled services, but three crew members were killed on a non-scheduled cargo flight. For the period 1956-60 inclusive, 0.8 passengers were killed per 100 million passenger-miles on U.K. scheduled services. In different terms, 199,800 passengers were carried safely for every passenger killed.

There were 20 accidents in 1960 involving public transport aircraft and 12 of these occurred on scheduled services. Of the 20, six were attributed to "faulty operation or omission" by pilots, and four were in part so attributed. There were 103 accidents to powered aircraft not engaged in public transport work, 10 of which were fatal and involving the death of 13 persons. Eighty of these accidents were attributed directly to pilot error and 10 were in part caused by such error.

These facts and figures are given in the Ministry of Aviation's "Survey of the Accidents to Aircraft of the United Kingdom" in the year ended Dec. 31, 1960 (H.M.S.O., 4s. 6d.)—which was issued last week.

Non-fatal accidents are not subjects for official reports and the events and causes are rarely explained by the airlines concerned—so the majority of the brief summaries in the survey provide previously unpublished facts.

For instance, the near-catastrophe on March 14, 1960, involving a B.O.A.C. Comet 4 on its approach to Madrid was reported (see our issue of March 25, 1960, p. 361), but the details could not be confirmed. Here is the Ministry's summary:

> During a final approach to land at night the aircraft struck a ridge at a point 345 ft. above runway level and approximately two miles from the runway threshold. As a result of the impact the wheels of both main landing gears and the fuel tank attached to the port wing were torn off and the port wing flaps damaged. The approach was discontinued and an emergency landing, with damaged landing gear down, was made on another runway.

Another accident, involving a Comet 4 at Cairo Airport on Aug. 22, passed off without public reference—though this, again, might well have been disastrous. The summary reads:

> The aircraft began its take-off run on a section of runway declared closed because of work in progress. At a speed of about 50 kt. the port main wheels entered an excavated hole and axles and wheels became detached. The take-off was abandoned.

No information was made available, either, about the causes of the landing accident involving a B.O.A.C. Boeing 707 at Heathrow on Dec. 24, 1960—though the organization and engineering involved in the removal of the wreckage received some attention. The survey says this about the accident:

> Following the aircraft's approach to runway 23L, during which information on height and heading had been transmitted to it by Air Traffic Control, braking action failed to check the aircraft's speed sufficiently to permit a normal turn-off. Approaching the end of the runway, an attempt was made to prevent the aircraft over-running by turning on to an intersecting runway, but it skidded sideways on to grass and the main landing-gear units collapsed.

Change of Policy in Canada?

A CANADIAN correspondent, commenting on the recent statements by the Minister of Transport (see our issue of Dec. 14, p. 756) and by the presidents of the two principal airlines (last week's issue, p. 782) writes:

The current discussion of airline merger, or alternatively the formation from T.C.A. and C.P.A. of a consortium to operate in the international field, began about a year ago with the report of an inter-departmental committee of the Federal Government, which reviewed various alternative courses for Canadian aviation policy and selected these two as the most promising.

Either would represent a major change in policy for the Conservative Government now in power in Ottawa and it is considered unlikely that the Cabinet will go much beyond the Minister's general statement of policy objectives before the next federal election—expected sometime in 1962 and probably in the spring.

Both major Canadian airlines are deeply in the red this year. T.C.A.'s deficit is expected to be about $7,500,000 for 1961 and C.P.A.'s will probably be on about the same level or somewhat greater. A combination of causes is involved.

C.P.A. received its first turbojets late in the spring and until then had been operating Britannias and DC-6s against turbojet competition, with correspondingly adverse load factors. Since then, it has had the added costs associated with the introduction of a new fleet.

T.C.A.'s Vanguard difficulties have added to its deficit, particularly through the necessity of carrying out unscheduled overhauls on much of its Super Constellation fleet which had been scheduled for gradual retirement on a time-expired basis. Loss of Vanguard productivity has also been a factor.

Both airlines have suffered from the unexpectedly heavy diversion of first-class to economy travel resulting from the revised fare structure introduced on Jan. 2, 1961. This has been about 20% heavier than anticipated, with a corresponding effect on revenues.

Air Transport . . . .

U.S. Airline Results, 1961

FOR the first time since 1948, U.S. domestic trunk airlines as a group have recorded an annual loss. According to Air Transport Association estimates, based on results for the first nine months, the net loss after taxes and interest will be about $30 million. This is the biggest loss on record, the previous "high" being $20.2 million in 1947. The loss in 1948 was $4.9 million.

Statistics which are tabulated here show that revenues of the U.S. trunk airlines increased by 4% compared with 1960 (the 1960 increase over 1959 was 8%). Total operating expenses increased by 6.1% over 1960 (the 1960 gain over 1959 was 12.6%).

Primary reasons for the failure of revenues to keep pace with expenses, according to the A.T.A., were the decline in passenger growth and the big swing of traffic away from first-class to low-fare services. A U.S. Government directive to civil servants to use coach-class travel where possible led many private companies to issue similar instructions. With jet equipment on most important routes, coach travel is now no hardship; one airline president commented recently that "our coach passengers today look like the blue book of industry."

Coach traffic in 1961 accounted for 57% of the total on domestic trunk flights, compared with 49% in 1960 and 43% in 1959. With an average revenue of 5.3 cents per passenger-mile in coach class and 7.2 cents per passenger-mile in first class, and assuming that all the increase in coach class in 1961 was at the expense of first class, it can be calculated that this 8% swing alone cost the airlines $13 million.

Total passenger-miles flown by the 11 trunk carriers in 1961 showed a 1.1% gain on 1960, to 29,500 million. By comparison, the 1960 gain was 3.9% and the 1959 gain was 15.3%. Available seat-miles on trunk operations increased by 7.7% with a consequent reduction in load factor from 59.4% to 55.8%.

There was a decline in the number of passengers carried by the entire U.S. scheduled airline industry, but a 2.49% increase in domestic and international passenger miles. A 12.6% increase in freight and 22.3% increase in mail helped to take the total revenue ton-miles over the 1,000 million mark for the first time in a year.

During 1961 the airlines added 142 turbojet and turboprop aircraft to their fleets, to make a total of 571 at the end of the year. This compares with 429 at the end of 1960. Announced orders call for delivery of 60 more pure jets in 1962 and 40 in 1963. The total airline fleet, including piston-engined types, remained stable during 1961 and numbered 1,867 at the mid-year point.

Up to the end of November the safety rate on U.S. scheduled airlines was 0.32 fatalities per 100 million passenger miles. (There had been no fatal accidents in U.S. scheduled operations during December up to the time of going to press.) By comparison, the rate was 0.62 in the first 11 months of 1960 and 0.86 for the calendar year 1960.

Among other A.T.A. statistics for 1961 is a figure of 171,000 employees in the U.S. scheduled airline industry, compared with 26,000 in 1941. The annual payroll is over $1,000 million. The airline fleet represents less than 2% of the total 111,000 civil and military aircraft using the U.S. airspace. In terms of flying hours, the airlines accounted for 15.7% of the total.

U.S. AIRLINE INDUSTRY 1961 RESULTS

	1961 (Estimated*)	1960	% Change
Number of passengers	57,600,000	57,700,000	− 0.17
Revenue passenger-miles	39,800,000,000	38,834,100,000	+ 2.49
Freight ton-miles‡	724,800,000	643,600,000	+12.62
U.S. Mail ton-miles	294,200,000	240,600,000	+22.28
Express ton-miles	59,400,000	59,100,000	+ 0.51
Total revenue ton-miles†	5,373,900,000	4,999,900,000	+ 7.48

FINANCIAL RESULTS. DOMESTIC TRUNK AIRLINES

	1961 (Estimated*) (millions)	1960 (millions)	% Change
Operating Revenues			
Passenger	$1,825.9	$1,756.4	+ 3.9
Freight	82.3	74.8	+10.0
U.S. Mail	48.1	44.8	+ 7.4
Express	20.9	21.9	− 4.4
Other	43.6	44.9	− 2.8
Total revenues	2,020.8	1,942.6	+ 4.0
Operating expenses	2,023.7	1,907.8	+ 6.1
Net profit (after T. and I.)	(30.0)	1.2	—

* Estimates based on reported figures for three quarters; fourth quarter estimated.
† Total includes charter and excess baggage ton-miles.
‡ Includes cargo (express and freight) of Alaskan, international and overseas airlines.

U.S. AIRLINE TRAFFIC RESULTS, 1961 COMPARED WITH 1960

DOMESTIC OPERATIONS

Domestic Trunk Airlines:	1961 (Estimated*)	1960	% Change
Number of passengers	44,200,000	45,200,000	− 2.21
Revenue passenger-miles	29,556,100,000	29,233,200,000	+ 1.10
Freight ton-miles	374,800,000	321,000,000	+16.76
U.S. Mail ton-miles	143,000,000	130,900,000	+ 9.24
Express ton-miles	55,700,000	55,400,000	+ 0.54
Total revenue ton-miles†	3,425,400,000	3,332,500,000	+ 2.79
Local Service Airlines:			
Number of passengers	6,400,000	5,600,000	+14.29
Revenue passenger-miles	1,334,000,000	1,141,600,000	+16.85
Freight ton-miles	5,400,000	3,800,000	+42.11
U.S. Mail ton-miles	3,300,000	2,700,000	+22.22
Express ton-miles	3,000,000	2,400,000	+25.00
Total revenue ton-miles†	141,200,000	121,200,000	+16.50
Certificated Helicopter Carriers:			
Number of passengers	445,000	490,000	− 9.18
Revenue passenger-miles	8,857,000	9,476,000	− 6.53
Freight ton-miles	12,000	7,000	+71.43
U.S. Mail ton-miles	93,000	91,000	+ 2.20
Express ton-miles	40,000	40,000	0.0
Total revenue ton-miles†	995,000	1,052,000	− 5.42
TOTAL DOMESTIC (Excluding All-Cargo Airlines)			
Number of passengers	51,000,000	51,300,000	− 0.59
Revenue passenger-miles	30,899,000,000	30,384,300,000	+ 1.69
Freight ton-miles	380,200,000	324,800,000	+17.06
U.S. Mail ton-miles	146,400,000	133,700,000	+ 9.50
Express ton-miles	58,700,000	57,800,000	+ 1.56
Total revenue ton-miles†	3,567,600,000	3,454,800,000	+ 3.27

INTERNATIONAL AND OVERSEAS

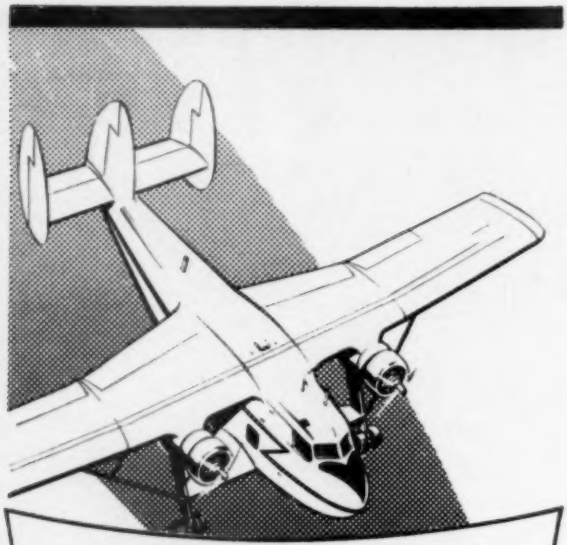
U.S. Flag International Airlines:	1961 (Estimated*)	1960	% Change
Number of passengers	5,400,000	5,200,000	+ 3.85
Revenue passenger-miles	8,563,500,000	8,132,700,000	+ 5.30
Cargo ton-miles	208,300,000	184,900,000	+12.66
U.S. Mail ton-miles	129,200,000	92,400,000	+39.83
Total revenue ton-miles†	1,326,000,000	1,159,700,000	+14.34
Alaskan Airlines:			
Number of passengers	400,000	400,000	0.0
Revenue passenger-miles	212,100,000	189,600,000	+11.87
Cargo ton-miles	10,600,000	8,700,000	+21.84
U.S. Mail ton-miles	5,100,000	4,200,000	+21.43
Total revenue ton-miles†	48,200,000	45,000,000	+ 7.11
Intra-Hawaiian Airlines:			
Number of passengers	800,000	900,000	−11.11
Revenue passenger-miles	126,200,000	127,500,000	− 1.02
Cargo ton-miles	1,800,000	1,800,000	0.0
U.S. Mail ton-miles	100,000	90,000	+11.11
Total revenue ton-miles†	12,600,000	17,700,000	−28.81
TOTAL INTERNATIONAL AND OVERSEAS			
Number of passengers	6,600,000	6,600,000	0.0
Revenue passenger-miles	8,901,800,000	8,449,800,000	+ 5.35
Cargo ton-miles	220,700,000	195,400,000	+12.95
U.S. Mail ton-miles	134,400,000	96,700,000	+38.99
Total revenue ton-miles†	1,386,800,000	1,222,400,000	+13.45
ALL-CARGO AIRLINES			
Freight ton-miles	123,900,000	123,400,000	+ 0.41
U.S. Mail ton-miles	13,400,000	10,100,000	+32.67
Express ton-miles	700,000	1,100,000	−36.36
Total revenue ton-miles†	419,500,000	322,800,000	+29.96

* Estimates based on reported figures for three quarters; fourth quarter estimated. † Total includes charter and excess baggage ton-miles.

WHEN SECONDS MEAN **SURVIVAL**

.....it is then that a Martin-Baker ejection seat really proves its worth. In the dramatic photograph above, recently released by the United States Navy, the pilot of a Chance Vought F8U-1 Crusader can be seen escaping from his burning aircraft just before it plunged over the side of the aircraft carrier Franklin D. Roosevelt. The ejection seat used, a Martin-Baker Mk.F5, was one of several thousand supplied to the United States Navy as standard equipment for ten different types of their fighter and strike aircraft.

MARTIN-BAKER



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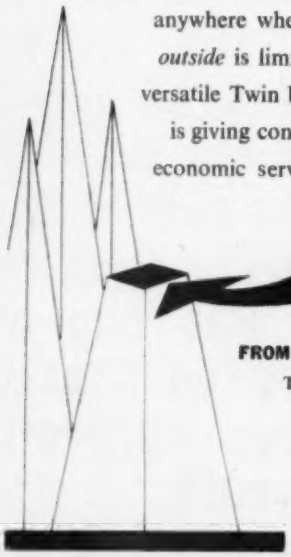

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Jan. 3rd issue: **'Buying a car under £625'**

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Air Transport . . . .

Educating Airline Engineers

In this article, MR. J. J. EDEN, *powerplant engineer with T.C.A., outlines the broad educational background required by modern airline engineers. The requirements for production and maintenance engineers were discussed in an article in our issue for Sept. 7.*

AIR TRANSPORTATION has grown steadily in the past and promises to continue growing in the foreseeable future. Yet this most steadily expanding sector of the aviation industry is, perhaps, the only one which has not received the support of a systematic and scientific approach to the pre-training and development of the specialist engineers who, to a great extent, influence the technical refinements within the airline industry.

A number of graduate and post-graduate courses in aircraft engineering are now available. Their curricula, however, are fashioned to produce the best background for engineers entering the research, design and development sections of the aviation industry. To have graduated from a specialized course in aeronautics undoubtedly gives the airline engineer the best available educational foundation today. This, however, falls far short of the education a course fashioned for airline engineers could provide in the same time interval. How, then, do the contributions required of an airline engineer differ from those required of his colleagues in the other sectors of the aviation industry?

The airline engineer's contribution must be primarily technical—his background and knowledge foundations must therefore be strongly technical; he must have a good knowledge of aerodynamics, structural design, drafting, chemistry and materials, thermodynamics and principles of propulsion, electricity, electronics, instrumentation and communication systems, aircraft performance and flight testing. Through this background, he must have a strong feel for the aircraft as a whole, as an operating entity, and yet prepare himself for the fact that the weakest link is usually in the detail design of an individual part—that great improvements in safety or major economic savings come from the refinement of detail.

He will be required to deal at all organizational levels within his company and with all technical and often commercial levels of the manufacturers in respect of the selection, specification, purchase, pre- and post-delivery development, acceptance testing, operation and maintenance of the equipment. He must be able to deal with broad airline concepts as well as technical detail with specialists in the respective fields.

The airline engineer's efforts must be directed towards the overall airline objectives. These, in turn, create specific and specialized requirements, broader than those usually encountered at the working level in the research and design field.

Generally, the setting of airworthiness standards is considered a primary function of the airline engineer. A study of the organization of existing regulatory authorities, the published regulations and methods used to implement these is required. Case studies of actual incidents and accidents to determine major causes of danger and studies of action taken as a result of accidents should be carried out. The procedures adopted following an aircraft accident and the steps involved in carrying out accident investigations and preparing accident reports should be reviewed.

With the exception of newly purchased aircraft, the airline engineer is dealing with equipment used in service. Defect investigation, the study of failed parts and wear patterns and the story these can reveal, if observed with understanding, are an important phase of the process of overcoming problems and developing improvements. A study of examples of failures and resultant developments carried out in the past could save experiments and errors in the future.

He will be issuing acceptance standards for component tolerances, functional test schedules and operating procedures and, apart from detail knowledge of standards as they affect mechanical components, he should appreciate their significance and effect on airline economics. He will be issuing modifications and repair schemes and will need a good knowledge of detail design and stressing, checking of drawings, fabrication, production and repair processes. He will require a good knowledge of the design and limitations of tools, jigs and fixtures.

He should be well acquainted with up-to-date systems of inspection, preparatory processes, measuring devices, radiography and X-ray methods. Theories associated with the development of component times between inspections and operating life limitations of parts should be known and understood.

The airline engineer will be involved in assessing the significance of failures and will be establishing trials of new modifications or procedures. He should be well acquainted with methods of statistical analysis to enable him to establish significances, sample sizes, etc.

He needs to be familiar with the preparation of test specifications for powerplants and units as well as the specification, design and operation of test-beds and accessory rigs, overhaul and maintenance equipment. He requires knowledge of airport operational ground equipment such as that for refuelling and passenger, cargo and commissary handling equipment. He will be involved in flight testing and reduction of flight test results as well as analyses of current operational records and performance.

From his knowledge of chemistry, he will particularly be required to deal with fuel specifications and analyses of fuel problems and lubrication problems. He should be acquainted with processes used prior to inspection, such as paint stripping, cleaning, chemical processing, heat treatment, painting and protecting of materials. From his knowledge of physics, the fields of vibration and noise will be most applicable. A broad technical field in which errors are inadmissible faces him.

However, the purely technical field is insufficient for the background of the best airline engineers. The influence of non-technical factors of airline operation is very strong and must be duly recognized.

Physiological aspects are directly involved in transportation. Passenger and crew comfort, seating, temperature, pressurization, noise, vibration, colour schemes, crew reaction times, fields of vision, human fatigue, illumination effects, etc., are fundamentals in the science of air transportation.

Airline economics should be understood. The theory of transportation, indirect effects on economy, company budgeting, accounting, financing, costing, profit and balance sheets,

DUTCH LINE.—A recent picture of the F-27 production line at Schiphol, showing two Friendships for Sudan Airways nearing completion.

Air Transport . . . .

depreciation policies, performance analysis of routes and equipment, market research, aircraft routeing and reserve policy, etc., should be studied.

A basic knowledge of planning methods, stores handling, operations research, application of electronic computers, etc., is useful and applicable. Industrial problems and union relations are necessary fields for the development of knowledge.

Legal aspects of air transportation such as airline liability to passengers and property and insurance policies should be understood. The structure and function of the international aviation agencies and particular national policies and procedures in respect to aviation should be studied.

The engineer in an airline finds himself involved directly or indirectly in management and administration work soon after joining an airline. This more so and sooner than in the case of employment with large manufacturers. Good writing and reporting are essential in order to present clearly programmes involving refined technical aspects in an environment which has primarily non-technical influences.

An airline engineer will be the contact between the airline and the respective government authorities as well as manufacturers. In addition, he will be representing the airline at technical meetings, local, national and international. He must have the aptitude for crystallizing his thinking and concepts towards clear objectives and the ability to express these clearly.

He will be involved continuously in meetings and conferences within and outside the company. He should have training both as a conference member and as a chairman.

Due to the large volume of communication inside and outside the company, he should develop proficiency in letter-writing, dictation and the use of dictating machines.

Last but not least, there is the field of human relations. An aircraft in operation is extremely sensitive to the influence of human error. In a manufacturing plant, stress calculations are checked, drawings are checked, production and output are inspected, often followed by inspection by the purchaser prior to use. An aircraft in service is dependent much more directly on the person handling the equipment. A fuel cap improperly tightened, an over- or under-torquing of a nut, incorrect installation of a filter, a mistake in calculating required fuel loads, the determination of a directional bearing, the handling of a wrong lever—all these directly influence the safety and success of the operational end product—a flight of passengers from A to B. Due to his direct working contact with employees in many different sections of the airline operation, questions of human relations involve the airline engineer more directly than many other engineers, and stress should be laid on systematic training in this field.

Recognition of the requirements for trained airline engineers has not yet gained general acceptance. Only a small number of airlines—those with far-sighted management—have to date created an environment within their companies where the potential contribution of such engineers can truly be tested.

The airline engineer's status has also not been as stable as his contribution warrants. One of the reasons for this has been the lack of specialist education available and, hence, the considerable training time resulting within the airline before "generalized engineers" become "airline engineers."

The rapidly expanding air transportation industry is precariously balanced between profit and loss. To exploit the potential benefits which air transportation has to offer in all its aspects, a healthy economic foundation is required. To ensure the best economic returns in airline operation, a high degree of continuous innovation within an airline in methods, procedures and processes is required.

By the basic nature of the work airlines perform, a large requirement exists for innovation involving technical problems, and, therefore, for managers with a high overall understanding of airline operation and a strong technical background.

This continuous requirement appears sufficiently large over the foreseeable future to warrant the establishment of at least one graduate or post-graduate course in airline engineering.

The rate of progress of air transportation is dependent on the refinements of airline operation. The well-trained airline engineer is a fundamental contributor towards this progress. The better his training, the greater the strides which air transportation will make.

OPtional Reading—26

IF we are talking of all-weather landing as defined in OPtional Reading 25—that is zero ceiling and 50 yd. runway visual range—it is not enough for the automatic equipment to put the aircraft on the runway about 1,000 yd. from the threshold and then say to the pilot: "All yours." The modern aircraft will be doing some 100 kt. at that point; there may be a cross wind and a wet runway, and keeping the aircraft tracking down the middle is, especially in the case of the swept wing, a matter of extreme skill and judgment. I do not know the minimum visibility distance needed by a pilot to keep an aircraft straight while decelerating from 100 kt. in something of a cross wind, but it is certainly more than 50 yd.; probably it is more than 200 yd. So, if we are talking of landing in fog, the automatic equipment will have to keep the aircraft straight for the roll-out

I have not come across any equipment which claims to be able to do this. It is a pretty tough job. Here, for example, is part of the landing instructions from a Boeing publication:

> ". . . when runway conditions are slick, brakes may not be sufficient to prevent asymmetrical thrust from veering the airplane to one side. Under certain conditions, reverse thrust and a strong cross-wind may drive the airplane off the centerline. Corrective action to straighten the airplane roll path is to return all engines to forward thrust (to reduce the thrust element tending to drive the airplane to the side and to get the airplane back near the center of the runway) and use differential wheel brakes and rudder to straighten the landing roll. Once the airplane is straight with the runway and near the center, thrust reversers should again be set up symmetrically if needed. . . .
>
> "To correct an airplane's veering course due to anti-skid cycling and cross-wind effects, let off on both brakes while keeping wings level. Immediately apply differential braking on the side necessary to bring the airplane back toward the center of the runway. When the airplane is again rolling parallel with the runway and near the center, apply pedal pressure to develop maximum braking. This calls for adjusting pedal pressure such that an anti-skid release occurs about once every two to three seconds. An anti-skid release can be felt by a kick in the brake pedals. The rudder should also be used to maintain directional control. Under emergency conditions nose-wheel steering can be used for directional control rather than differential braking."

With the above circus feat (or *feet*) to emulate, it is small wonder that the autocontrols are anxious to sign off at the point of touchdown and to switch on a record: "You never get a cross wind and fog together; so you will be quite all right, old boy." The experienced pilot simply will not swallow this, and nor will he agree that a cross wind is the only factor which may make it difficult to keep on the runway. Thrust reversers are great things, but they are a long way from perfection and failure of one engine to reverse is a common occurrence. For this the instructions read:

> "If one reverser should fail to move into reverse position immediately, its opposite should also be left at the interlock. The pair of engines that were originally left at interlock may be tried again in case a slow-acting rather than a malfunctioning reverser caused one reverser lever to stop at the interlock position."

With the above type of problem to cope with from touchdown to the end of the landing roll the autocontrols do not want the job and nor does the pilot *unless he has enough visual range to keep the aircraft straight*—and that is much more than 50 yards. I suppose that automatic roll-out equipment could be developed to take inputs from aircraft heading and attitude, speed brakes, anti-skid brakes, thrust reversers, throttles and nose-wheel steering; and I suppose that thrust reversers can be expected to improve in reliability and reaction period. But, even if this is the case, long before you have got to the point of turning off the runway you have fed in so many variables that the result simply cannot be predicted.

First of all, you have started off with a localizer input which, under somewhat exceptional conditions of expert maintenance and very close monitoring, can just give the required accuracy (save in the unlucky event of a reflected return bouncing off an overflying aircraft); you have filtered out the noise and, by a very elaborate system of alternative or redundant channels, have correctly positioned the aircraft in the landing funnel at a height of some 200 ft. on a good glide path but higher on a bad one; you have then accepted a period of attitude holding and an angle of descent which is only approximately correct; you then recover glide slope at the threshold, using a radar altimeter signal which has got to have accuracy and reliability factors better than 10^{-8}. During this period you are in a regime where airspeed inputs are critical and tend to be inaccurate and where the aircraft configuration is probably changing due to flaps. Having sorted all this out and got to the point of holding off, you feed in a drift correction partly dependent on the accuracy of the compass system (or perhaps the Doppler)—and you have then got the aircraft to the point of touchdown. Is this not enough, without adding in the above mentioned roll-out variables?

C'est magnifique, mais ce n'est pas l'aérogare.—C.C.J.

The Fighting Services

R.N.Z.A.F. Officer Training

AN officer cadet training scheme for the R.N.Z.A.F., whereby military training is provided at Wigram and academic subjects dealt with at Canterbury University, New Zealand, is to be introduced next year.

The scheme is designed to provide the Service with career officers to fill its higher command appointments in the flying, technical, administrative and supply branches. In the past, selected officer cadets have been sent to the R.A.F. College, Cranwell, and the R.A.A.F. College, Point Cook, but because of high cost the quota for each college was rarely more than one cadet each year.

Cadets recruited into the scheme will undergo a four-year course at Wigram in conjunction with the University. To start in January, it will be limited to one 10-cadet course each year. Under its present scheme the R.N.Z.A.F. selects the majority of its career officers from those holding short service commissions.

Sabre Team Returns Home

THE R.C.A.F. team which went to Germany three years ago to help the West German Air Force train its Sabre pilots has now returned to Canada.

In 1958 the Luftwaffe acquired 300 Sabres—225 Sabre 6s purchased directly from Canadair and 75 Sabre 5s under a Canadian mutual aid grant. Germany first asked for the R.C.A.F. team as an assignment, on loan, for 1½ years, and three times has obtained six-month extensions of the agreement.

At first, the R.C.A.F. personnel were assigned simply to advise the Luftwaffe in undertaking advanced training on the aircraft, and to assist in running the Sabre operational training unit. But as it turned out, the Canadians did much of the actual flying instruction as well. Whereas in the beginning many of the R.C.A.F. men were ground-crew technicians, most of the 40-man team which completed the mission last month comprised flying personnel.

During the three years, besides doing the advisory work, the Canadians trained more than 200 German pilots at Oldenburg, without a single major accident. C.O. of the R.C.A.F. team was Sqn. Ldr. W. Moore, an Englishman who got his wings in Canada under the Commonwealth Air Training Plan.

A Gift to Australia

A SPITFIRE Mk. 14, at present on display at the Aircrew Selection Centre at R.A.F. Hornchurch, has been offered by the Air Council to the Kingsford Smith Memorial Collection at Canberra, Australia.

This particular Spitfire was refurbished last year and is in good condition, but it is not airworthy. It has a 2,050-b.h.p. Rolls-Royce Griffon engine. Bearing the serial number RM694, it was delivered to the Royal Air Force in July, 1944, and was issued to No. 91 Squadron at Deanland, an advanced landing ground near Eastbourne.

It was used in action against the flying bombs and was subsequently transferred, with other No. 91 Squadron aircraft, to No. 402 (Canadian) Squadron stationed at Hawkinge. Soon after going with the Squadron to Antwerp, while being flown by the Squadron C.O., it was crash-landed due to engine trouble and badly damaged. RM694 was then sent to No. 6 maintenance unit at Brize Norton in 1945 for a rebuild: and in January, 1946, was issued to the Central Fighter Establishment at West Raynham. It suffered another accident in November, 1948, and in February of the following year was renumbered 6640M, and was converted for ground instructional duties at R.A.F. Locking. In May, 1950, it was officially struck off charge and eventually found its way to Hornchurch for display purposes.

A.T.C. in Northern Germany

WITH 45,000 sq. miles of air space under its control, the Royal Air Force A.T.C. Centre at Hanover is responsible for all flights outside the civil airways that cross Germany. Its task is a particularly important one, as its area extends westwards to the Dutch border and north and south from Denmark to the American zone of Germany. Its responsibility also includes the control of civil and military flights along two of the three air corridors to Berlin.

Manned by fewer than 100 Royal Air Force officers and airmen under the command of Sqn. Ldr. A. Aldridge, this Centre is said to be one of the smallest but busiest units in Germany. During the past 12 months its Teleprinter Section has handled approximately 670,000 messages dealing with aircraft movements, warnings to aircrews on flying and navigation hazards and giving information on airfields. During peak periods as many as 18 signals a minute can be received and on some days no fewer than 3,000 are logged. The Centre has direct lines from Paris, Brussels, Amsterdam, London, Copenhagen and Frankfurt.

In addition to monitoring the progress of R.A.F. aircraft, the Hanover A.T.C. Centre also deals with those of other NATO forces using the airspace—American, German, Belgian, Dutch and Danish. It is also responsible for the co-ordination of flights in the military low-level flying practice areas in the zone and the control of traffic along the routes connecting them. This, it will be appreciated, is a particularly important task because it is essential—on safety grounds alone—that these low-flying areas are not overcrowded with aircraft.

Also at the Hanover Centre is an Aeronautical Information Service branch which carries information on weather, flying hazards and airfields all over the World so that queries from civilian and military bases can be dealt with without delay.

MANILA PRESENTATION.—At a ball after the Manila Air Show on Nov. 26 Brig.-Gen. P. Q. Molina, Commanding General of the Philippine Air Force (left), was presented with a replica of the crest of No. 3 Fighter Squadron, R.A.A.F., by Gp. Capt. I. F. Rose (right) and Wg. Cdr. R. H. Glassop, Squadron Commander. Gp. Capt. Rose, O.C., No. 78 Fighter Wing, led the R.A.A.F. team of six Sabres and two Canberras, from Butterworth, Malaya, which took part in the Show.

R.A.F. Appointments

THE following are among recent Royal Air Force appointments:—

Air Ministry: Wg. Cdr. T. A. Evershed to the Department of the Air Member for Personnel; Wg. Cdr. J. H. Spencer, M.B.E., to the Department of the Air Member for Supply and Organization.

Bomber Command: Wg. Cdr. T. M. G. Bury to Headquarters, No. 1 Group, as Senior Technical Staff Officer, with the acting rank of Gp. Capt.

Fighter Command: Sqn. Ldr. W. E. Satterthwaite to Headquarters, No. 12 Group, as Group Electronics Officer, with the acting rank of Wg. Cdr.; Sqn. Ldr. D. A. P. Saunders-Davies to No. 85 Squadron, West Raynham, to command, with the acting rank of Wg. Cdr.

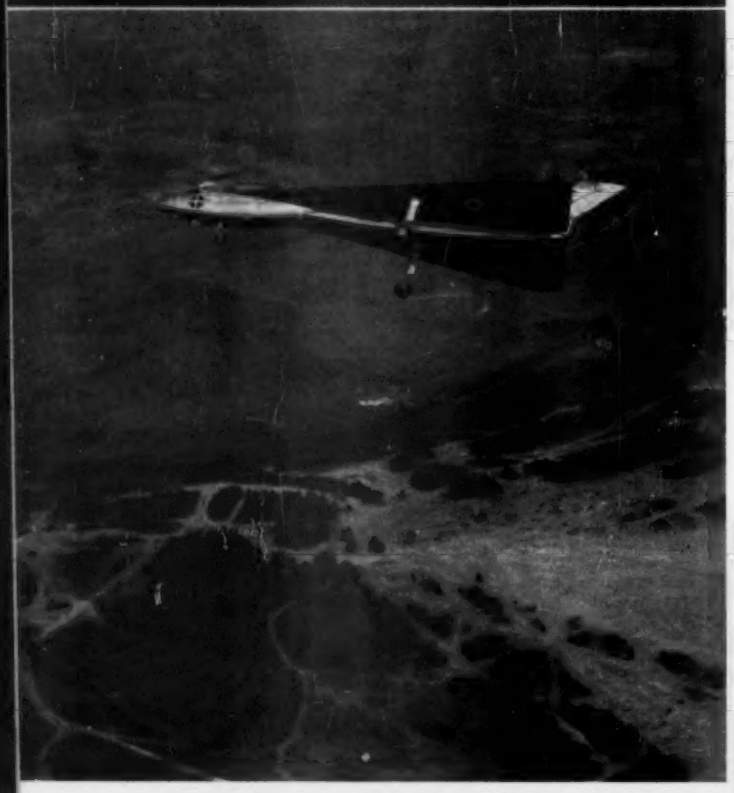
Flying Training Command: Gp. Capt. A. D. Button, O.B.E., to Headquarters as Command Education Officer; Wg. Cdr. H. T. Hardy, R.A.A.F., to the R.A.F. Flying College, Manby, as Senior Medical Officer; Wg. Cdr. J. W. Frost, D.F.C., to the R.A.F. Staff College, Bracknell, as Group Director, with the acting rank of Gp. Capt.; Wg. Cdr. H. J. Parker to R.A.F. Stradishall as Senior Technical Officer.

R.A.F. Germany: Gp. Capt. T. J. G. Price as specialist in Ophthalmology and Wg. Cdr. R. E. Woolley, G.M., as Deputy Principal Medical Officer, both to Headquarters; Wg. Cdr. E. E. Lloyd-Jones to Headquarters, for legal duties.

Air Forces Middle East: Wg. Cdr. H. A. N. Hamersley to the Aden Protectorate Levies Hospital, Aden, to command.

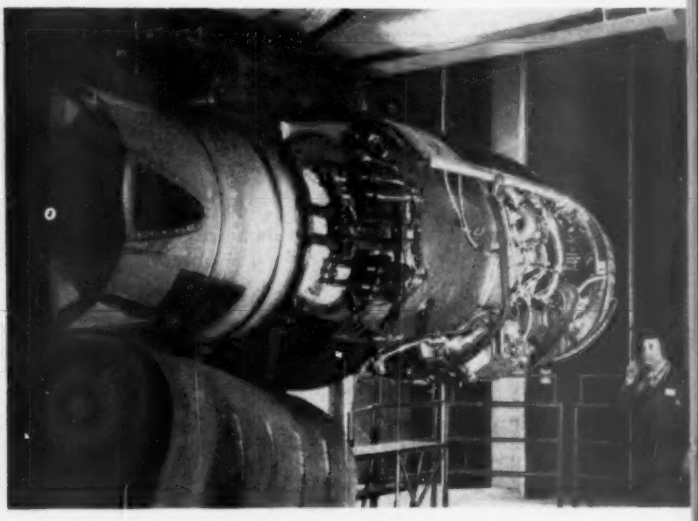
Other Appointments: Gp. Capt. P. M. Dobree-Bell, A.F.C., to Allied Air Forces Northern Europe as Assistant Chief of Staff, Logistics.

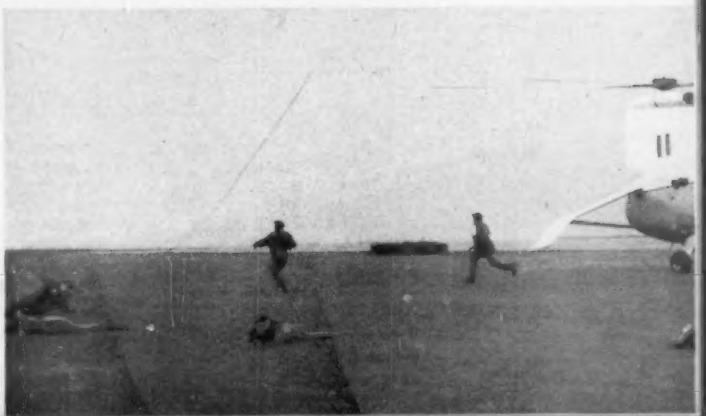
In the 1961 Limelight

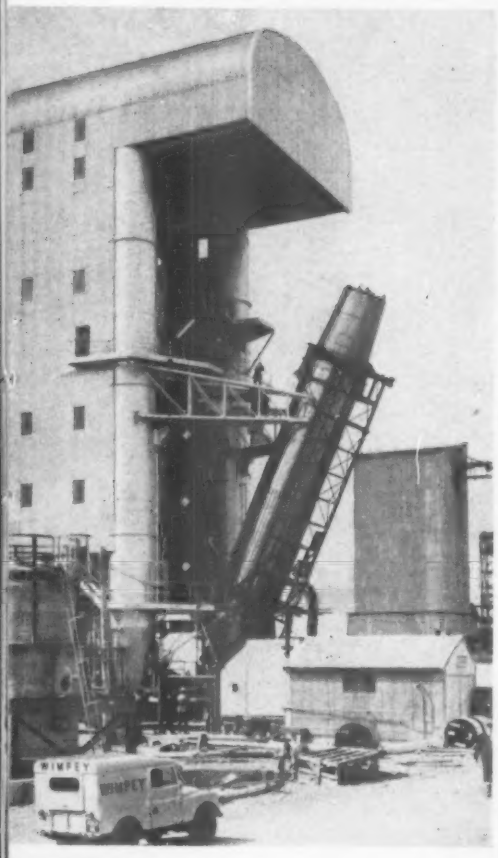


NEWCOMERS.—Above, top to bottom, three aircraft which have made their first flights during the past 12 months—the Aviation Traders Carvair vehicle-ferry (June); the Handley Page H.P.115 research delta for the supersonic transport programme (August); and the Beagle B.206 executive twin (August) representing the new Beagle range.

MANPOWERED.—History was made in November when Derek Piggott pedalled Southampton University's manpowered aircraft into the air for the first time. Within a few days a second British manpowered aircraft built by the Hatfield group also made its first flight.







SPACE BOOSTER.—Left, a brighter future for Blue Streak seems assured with the prospect of the formation of the European Launcher Development Organisation which will confirm its use as the first stage of a heavy European satellite launcher.

VTOL FIGHTER.—First transition from vertical to level flight by the remarkable Hawker P.1127 VTOL strike fighter, powered by a Bristol Siddeley BS.53 Pegasus lift-thrust engine, was accomplished in September.

NEW BY-PASS.—Left, the Rolls-Royce Spey by-pass turbojet began its flight test programme in October. It has been chosen to power the new de Havilland Trident and B.A.C. One-Eleven civil transports and, in a military version, the Blackburn Buccaneer S.2.

INTO SERVICE.—Among the aircraft which went into service in 1961 were: below, the Westland Belvedere helicopter with the Royal Air Force; right, above, the Handley Page Herald, which started scheduled service with Jersey Airlines in the summer; right, below, the Vickers Vanguard second-generation turboprop transport which started regular route service with T.C.A. in February and with B.E.A. in March.

Studying the Weather Hazard

BETWEEN 1953 and 1959, 62 cases were recorded in which military aircraft were either badly damaged or destroyed by weather activity above 25,000 ft. In many of these cases pilots had received accurate weather forecasts as to severe weather en route, and some of the aircraft carried weather radar. The fact that they were damaged in flight suggests that, despite accurate forecasting, certain regions exist where there is a severe weather risk at the higher altitudes. These regions are associated with convective activity. The hazardous areas are isolated points of extreme activity within the overall convective areas—e.g., in the most intense, hail-producing thunderstorm.

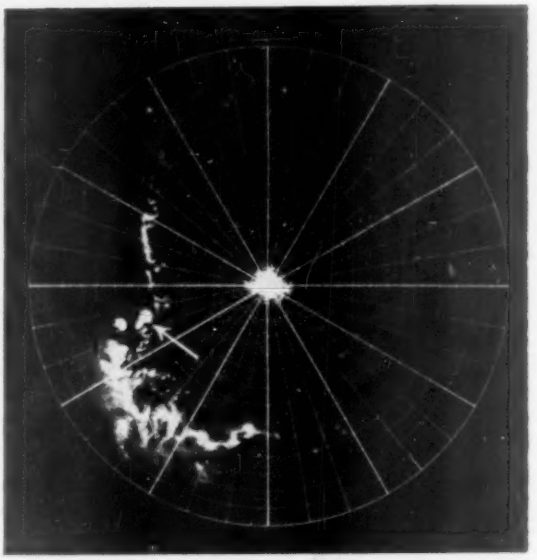
The aerophysics group at Stanford Research Institute California, has conducted a preliminary investigation of the prevailing meteorological conditions in 14 of the incidents for which radarscope films made at the time and vicinity of the accidents were available. Objectives of the study were to ascertain if: (1) the radar echoes showed any characteristic features that could be used to determine potentially hazardous flight conditions; (2) any significant features in the total weather patterns were common to the 14 cases; and (3) features within the gross patterns existed that were conducive to generation of severe, hazardous weather at high altitudes.

In all the incidents studied, radar echoes indicated an extremely intense convective activity. The reflectivity was so high that the scope appeared to be saturated even when the echoes came from the farthest detectable distance. Moreover, these echoes, when isolated from general precipitation echoes, were quite distinctive, and it is possible that even an inexperienced radar observer would be able to distinguish them in normal operations.

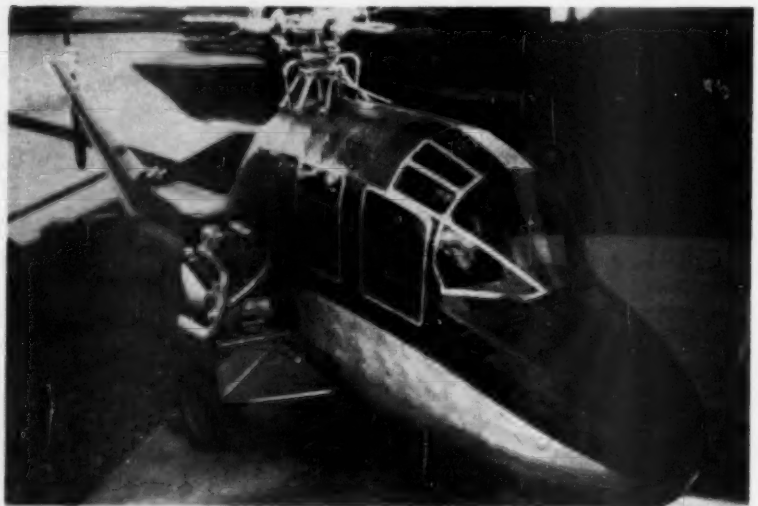
In some cases the convective activity took place along a line several hundred miles in length. One segment of this line travelled faster than the other, and the accidents associated with this pattern occurred where the two segments of the line met. This is significant, because, on the surface, the severest weather conditions, including tornadoes, have been found to occur at the counterpart of this area in squall lines.

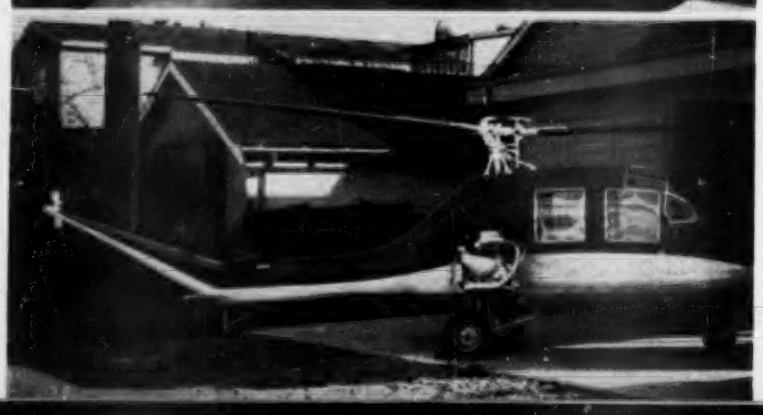
In studies of surface weather patterns, conditions existing prior to and at the times of the 14 accidents were categorized. The three classifications noted were found to be too common to be useful in themselves, but when related to features in the upper tropospheric wind patterns, they might well lead to specific determination of areas of potential hazard. This raises an interesting question as to what coupling exists between the lower atmospheric patterns and divergent wind patterns aloft. The research team's objective is to find the answer.

The project is sponsored by the U.S. Air Force Cambridge Research Division. Future research is aimed at finding data and knowledge to develop an atmospheric model that will allow objective forecasting of the hazardous conditions.



On the radarscope, one segment of a moving front is travelling faster than the other. Where the two segments meet, one of the intense, dangerous areas can be seen.





Twin-motor Helicopter

AN ultra-light helicopter prototype, built in Vancouver, B.C., is now undergoing ground tests. So far, results on structures, engines, transmission and controls have been satisfactory. An unusual feature of the new helicopter is that the two 1,000-c.c. 4-cylinder air-cooled engines are mounted outboard, one on each side of the fuselage behind the cabin.

No information is available about the power of the engines, nor whether they are two- or four-stroke. There is a 9-1 reduction between them and the main rotor.

Designed by Mr. Joseph Pidek of 1165 West 14th Avenue, Vancouver, an aeronautical engineer and former Polish Air Force pilot, the helicopter weighs 760 lb. It is built of steel tubing and wooden framing and much use is made of glass fibre. A correspondent reports that it has been built according to the Manual 6 for Rotorcraft of Normal Category.

Not enough information has been given about the design to indicate whether it should have the ability to fly on a single engine. The outboard mounting certainly makes for simplicity and ease of maintenance. It should also simplify cooling problems.

Preliminary estimates are that the machine could be sold for 10,000 dollars as a 2-seater.

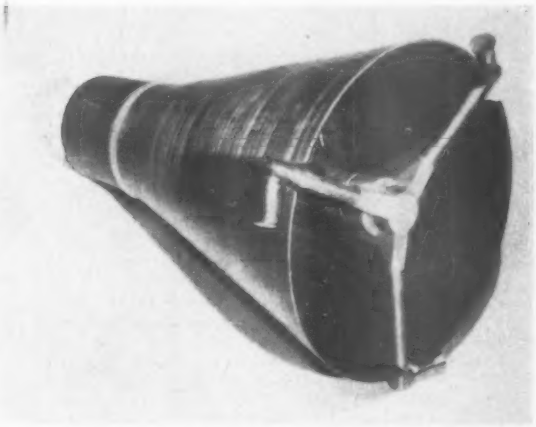
Putting a Radio Capsule on the Moon

DESPITE the troubles which have beset the beginnings of the Ranger programme, NASA intends to press ahead with an early attempt to rough-land an instrument package on the lunar surface. The ball-shaped capsule is being developed by the Aeronutronic Division of the Ford Motor Co., under contract with NASA's Jet Propulsion Laboratory. It is to travel aboard a Ranger spacecraft launched by an Atlas-Agena-B rocket and aimed on a 60-70 hour long collision course with the Moon.

Proving tests of the spacecraft itself have, of course, already taken place with Rangers I and II, although these vehicles were not allowed to perform as planned because of identical failures in the Agena-B boosters. After entering a parking orbit close to the Earth for 14 minutes, they were to be projected into elliptical trajectories extending some 500,000 miles into space, although not in the direction of the Moon. These test firings carried out on Aug. 23 and Nov. 18, 1961, were intended essentially to test the spacecraft's orientation system, and the opportunity was taken of mounting a number of scientific instruments for telemetering results back to Earth.

Apparently the cause of the Agena-B failure (at least in the case of Ranger II) was a stabilization fault which started the Agena stage spinning, thereby setting up a centrifugal action on the propellents causing them to "gravitate" to the tank walls. Even firing of the "ullage" rockets, intended to force the otherwise weightless propellents to the bottom of the tanks for feeding to the engine, proved inadequate and as a result the engine consumed only the amount of propellent which remained in the feed lines.

This deficiency must be rectified before any Ranger launchings are made to the Moon for the "re-starting" capability of Agena-B is fundamental to the procedure of aiming the spacecraft from a parking orbit some 115 miles above the Earth.



Spin-motor installed on the nozzle of the retro-rocket being developed for the Ranger lunar capsule. The "spinner" is intended to jettison when the braking rocket ignites above the surface of the Moon.

The Survival Package

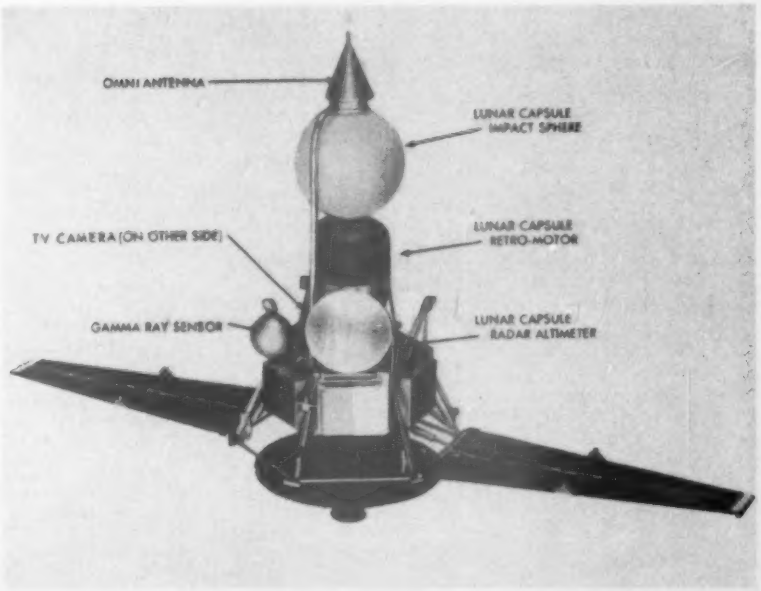
Assuming a successful launching and accurate guidance of the carrier, the Moon will be reached within 70 hours and at a distance of about 20-25 miles from the lunar surface the payload package will be detached from the Ranger spacecraft. Almost immediately, the capsule's retro-rocket will be fired to reduce the speed of impact with the Moon to less than 150 m.p.h. Ranger, however, will continue on to destruction.

Under contract to Aeronutronic, the Hercules Powder Company is developing the high-performance solid propellent retro-rocket, which will help to "soften" the capsule's landing. The motor weighs 195.9 lb. and is dynamically balanced to minimize alignment errors when the capsule is spin-stabilized. The spin rocket system is being developed by Aeronutronic and will be installed at the mouth of the retro-rocket nozzle. This unit is jettisoned when the retro-rocket ignites above the surface of the Moon.

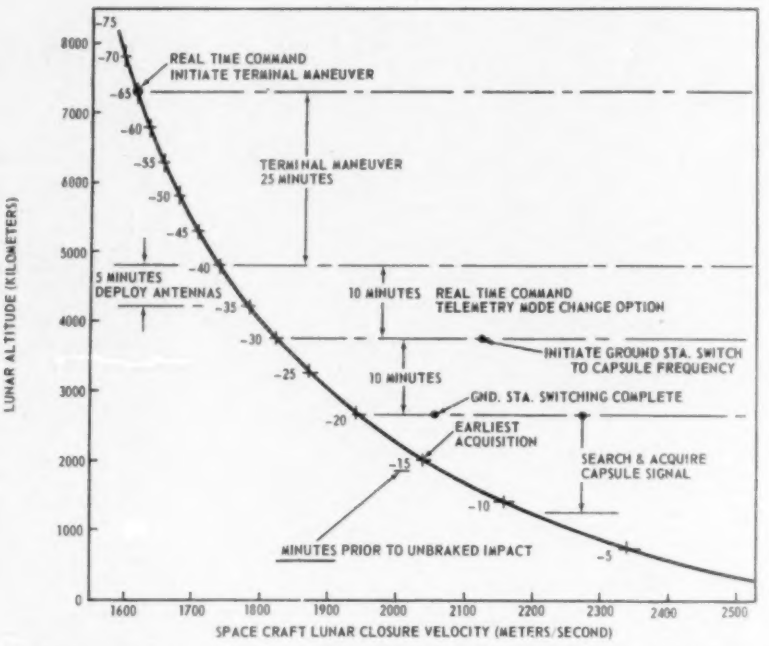
Terminal phase of the Ranger journey will be initiated by a 5-lb. altimeter being developed under an Aeronutronic subcontract by Wiley Electronics Company, a subsidiary of the Giannini Scientific Corporation. The altimeter will give the lunar capsule the "go" signal to separate from the spacecraft as it gets within the prescribed distance from the lunar surface. The altimeter should help to provide additional information concerning the exact position of the Moon with respect to the Earth.

Although the approximate position of the Moon is known, Ford Aeronutronic point out that the Earth-Moon distance is not known precisely enough to preset the time of separation of the capsule. Thus, as the Ranger carrier nears the Moon, a radio command signal from Earth will switch on the altimeter.

Following the system pioneered in aviation with the radio-altimeter, the device will reflect radio pulses from the Moon to determine the exact distance from the lunar surface. When these reflections show that the vehicle is at the desired distance from the Moon, a switch on the altimeter will close; the capsule



Principal features of the Ranger spacecraft complete with rough-landing lunar capsule.



Spacecraft closure velocity plotted against lunar altitude and showing the time sequence.

will separate from the spacecraft and in quick succession the spin-rockets will fire and the retro-rocket ignite.

The primary instrument aboard the rough-landing capsule is a seismometer and with this it is hoped to obtain data on any disturbances which may take place in the lunar crust for a period of several months. Astronomers have long speculated about the internal composition of the Moon and there is a good chance that shock waves reflected from the sub-strata, as a result either of crustal disturbance or the impact of meteoroids, picked up by the seismometer, will help to answer some long-standing scientific questions. This, of course, assumes that the capsule survives the landing. To enhance the survival prospect, Ford Aeronutronic have embodied an ingenious system of protection.

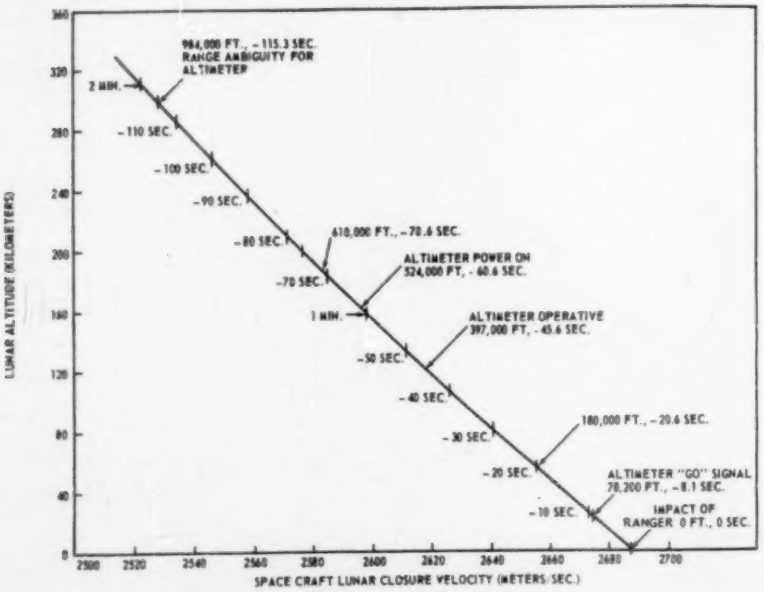
The total diameter of the landing sphere is 25 in., some 13 in. of which is accounted for by an outer casing of balsa wood. Inside this covering is the 12-in.-diameter survival sphere containing the scientific instruments and telemetry equipment.

As added protection, the sphere inside the balsa wood shell is surrounded by a flotation fluid to help distribute the structural loads of the lunar impact. This also has the important function of allowing the internal sphere to right itself to a vertical position under lunar gravity (only about $\frac{1}{6}$th that of Earth's) after the assembly comes to rest. The sensitive axis of the seismometer will then be in the correct position to transmit its findings back to Earth, with the telemetry antenna facing away from the Moon.

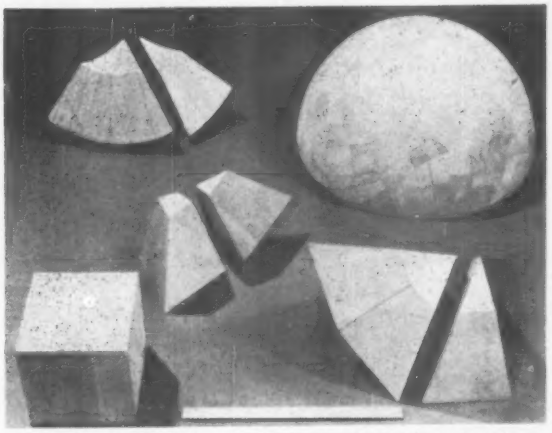
Ford Aeronutronic have sought to maintain an even temperature within the sphere by means of a cryogenic-type vacuum insulation and a small quantity of water ballast which keeps the temperature essentially constant despite external heating or cooling under lunar conditions. The severity of this problem can be judged from the fact that the Moon's surface temperature is estimated to drop to −250° F. at night and rise as high as 220° F. during the lunar day, each phase lasting about 14 Earth days.

Avoiding Contamination

Despite the rigorous conditions on the Moon which appears to preclude the existence of even the most primitive life forms, NASA is concerned that the Ranger vehicle and its payload do not transport Earthly bacteria to the lunar surface. To prevent any possibility of contamination, everything is being done to ensure that the entire vehicle is, in the words of Ford Aeronutronic, "hospital clean externally and sterile in all



Altimeter sequence and time to lunar impact in relation to lunar altitude and closure speed.



Elements of the balsa wood "impact limiter" designed to protect the instrument sphere in the lunar capsule being developed by Ford's Aeronutronic Division.

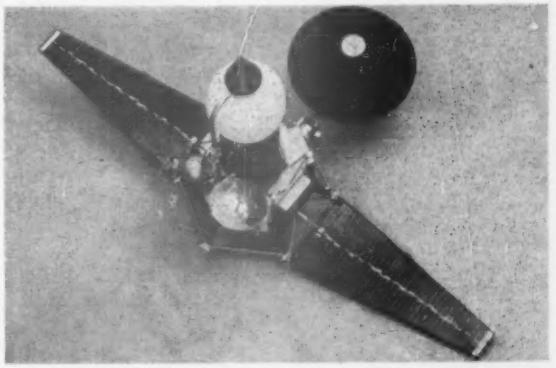
RANGER WEIGHT SUMMARY

		Weight (lb.)
A. Retrorocket Payload		
1.	Survival sphere, electronics, antenna, batteries, wiring	23.1
	Structure, insulation devices	14.4
	Water	3.6
	Seismometer	7.8
	Flotation fluid and outer shell	7.4
	Survival sphere total	56.3
2.	Impact limiter, cover and rocket motor/sphere interconnection	39.3
3.	Vibration damper	1.2
4.	Control timer, batteries, wiring	1.4
	Total retrorocket payload	98.2
B. Motors		
1.	Retrorocket motor and igniter	208.5
2.	Spin motor, igniter and attachment	2.2
	Total separate weight	308.9
C. Ranger-mounted Equipment		
1.	Altimeter and antenna	6.5
2.	Altimeter support and deployment	2.0
3.	Motor support structure and separation	3.6
4.	Ranger interface J-box and connectors	1.0
5.	Retrorocket heat shield	3.0
	Total lunar capsule	325.0

respects." Internal instruments " will be biologically sealed to further ensure sterilization requirements which will become most important for later planetary flights." It will, of course, be *vital* in the case of probing missions to Mars and Venus.

The main body of the Ranger spacecraft will carry a gamma-ray spectrometer and a television camera with the object of photographing the Moon up to the point of separation of the capsule. Separation of the capsule is expected to so disturb the stability of the carrier that further photography will be impossible. However, NASA is developing a further series of Ranger spacecraft which should be capable of photographing the lunar surface right up to the moment of impact.

Although the United States expects to get the first Moon-bound Ranger off the launching pad at Cape Canaveral fairly early in the New Year, the Russians are unlikely to let the challenge go unanswered. After all, they have a long record of " firsts " to maintain, including the World's first Earth-satellite, the first satellite around the Sun, the first direct hit on the Moon, first photographs of the hidden side of the Moon, and, of course, the first man into orbit. All things considered, 1962—astronautically speaking—should be an exciting year.



Model of the Ranger spacecraft showing the solar cell panels and antenna extended.

New Radiation Belt Discovery

ONE of the United States' most prolific satellites from the information point of view—Explorer XII—is reported by NASA to have made an important new discovery concerning the composition of the outer Van Allen Radiation Belt. Although the vehicle ceased transmitting recently, it is stated to have relayed to Earth more useful data on radiation in space than all other scientific satellites combined.

Launched by a Thor-Delta rocket from Cape Canaveral on Aug. 15, 1961, the 83-lb. vehicle entered a highly elliptical orbit extending from 182 miles at perigee to some 48,000 miles at apogee; the initial period was 26 hr. 25 min. During its effective lifetime of 112 days, it traversed the outer radiation belt 204 times in 102 orbits.

According to the Explorer XII project manager, Dr. Frank McDonald, of NASA's Goddard Space Flight Center, the satellite has given the information that there are a thousand times fewer electrons in the outer belt than previously believed and that protons are a major constituent. Data from earlier satellites had indicated that this outer belt had a higher concentration of electrons than protons.

The electron concentrations were measured by instrumentation furnished by Dr. James A. Van Allen and Dr. Brian J. O'Brien of the State University of Iowa. An experiment by Mr. Leo Davis of the Goddard Space Flight Center determined that the protons are a major constituent of the outer belt.

Although the energy of protons in this region is below one million electron volts and presents no hazard to manned space flight, measurements of the particles' energy content and spatial distribution are expected to add considerably to contemporary knowledge of geophysical phenomena in the Sun-Earth relationship.

Explorer XII ceased to transmit abruptly at 1.12 p.m. on Dec. 6. At that time, the Minitrack Station at Woomera in Australia was recording telemetry data and the signal was lost without any previous indication of failure. Following the Woomera report, a continuous monitoring schedule was started immediately by the entire Minitrack network but no further telemetry was picked up. It appears that the satellite can no longer transmit because of a primary power system failure.

When originally launched, Explorer XII was scheduled to operate for about one year. The orbital path has changed considerably since this time, the perigee increasing from 180 miles to 497 miles as a result of solar and lunar perturbations which pull the orbit outward. After 270 days, the satellite is expected to reach its maximum perigee at 620 miles. The perigee will then begin to contract with the satellite re-entering the atmosphere after possibly two years in orbit.

On four different occasions, Explorer XII monitored solar cosmic rays in interplanetary space. This eventually should provide a complete time history of proton events when all the data is analysed. However, it will not be until mid-1962 before the 2,500 miles of tape data—equivalent to more than 100 million five letter words—can be interpreted in detail. The satellite transmitted over 300 million " bits " of information, of which about 80% is stored on some 5,600 reels of tape.

Apart from the scientific experiments, Explorer XII pioneered the use of silver cadmium batteries and carried a solar cell experiment to measure the effect of the radiation belts on the cells. These cells convert sunlight to electricity which is then used to recharge the satellite's batteries.

Four banks of cells were placed on the outer surface of the Explorer vehicle. One bank was not protected while the remainder had 0.0003 in., 0.002 in., 0.006 in. of glass protective coatings respectively. On the first two orbits the power output of the unprotected bank degraded 50%. From then until the satellite ceased transmitting, degradation reached an additional 25%. Cells with 0.002-in. and 0.006-in. coverings did not degrade, but those with 0.0003-in. covering had about 5% degradation. Such engineering data will be exceedingly valuable in designing future solar powered satellites which have to traverse the radiation belts. Another point of interest is that solar pressure, which built up against the solar paddles while the vehicle was in sunlight, increased the satellite's rate of spin from 27 to 33 r.p.m.

THE AEROPLANE and ASTRONAUTICS
DECEMBER 28, 1961

Flying the Production Rallye

No. 109 in the Series

by John Fricker

MORANE-SAULNIER'S massive production programme for the little Rallye lightplane has suffered from the seemingly inseparable delays accompanying almost every aviation venture. After nearly a year of difficulties, complicated by a prototype loss during spinning trials at extreme aft C.G., production is now getting into its stride at the Tarbes factory, and the first British M.S.880B demonstrator, G-ARTT, was brought over by U.K. distributor Nat Somers a week or so ago, just in time for Christmas.

At its duty-paid and delivered price of £2,650, the arrival of the Rallye is a fine seasonal present for British private flying, although this sort of Christmas box may be less appreciated by the renascent light aircraft industry in this country than in others. There is no doubt at all that the Rallye represents a notable technical break-through, with the aid of considerable capital investment and production-line tooling, towards an aircraft capable of being turned out on almost automotive scale, with a corresponding reduction in unit cost.

With the Rallye, Morane-Saulnier have succeeded in establishing a new level, at the bottom end of the price scale, for a three/four-seater of modern layout and all-metal construction. Despite its unprecedented cheapness, however, there is very little of the "economy" aeroplane about the Rallye, which is comfortable, moderately quiet, very well finished and lavishly endowed with aids to low-speed performance. In most respects it conforms to established American standards with such items as toe brakes, cockpit heating and ventilating, tricycle undercarriage and so on, but its European origins are proclaimed by the retention of a non-steerable nosewheel and dual control columns instead of handwheels.

The latter are available for export models, but the cockpit of G-ARTT had the normal stick arrangement I remembered from several flights in the prototype M.S.880, which was described earlier in this series (No. 81, Aug. 5, 1960). There are quite a few changes in production aircraft, although the essential character of the Rallye has remained unaltered. Externally, the most obvious are in the revised rear fuselage and swept fin, although the nosewheel suspension has also been redesigned, and there are now lever-type oleos on all three undercarriage legs, with no fairings.

The sliding canopy now has a "straight-line" top for more rear-seat headroom, and is almost a true bubble type. Light and flexible transparent material and absence of supporting framework can lead to distortion if excessive force is applied to the canopy, which was slightly stiff on the brand-new British demonstrator. Cabin sealing, on the other hand, was absolutely first class, with no trace of draught, while the all-round view is nothing short of superb.

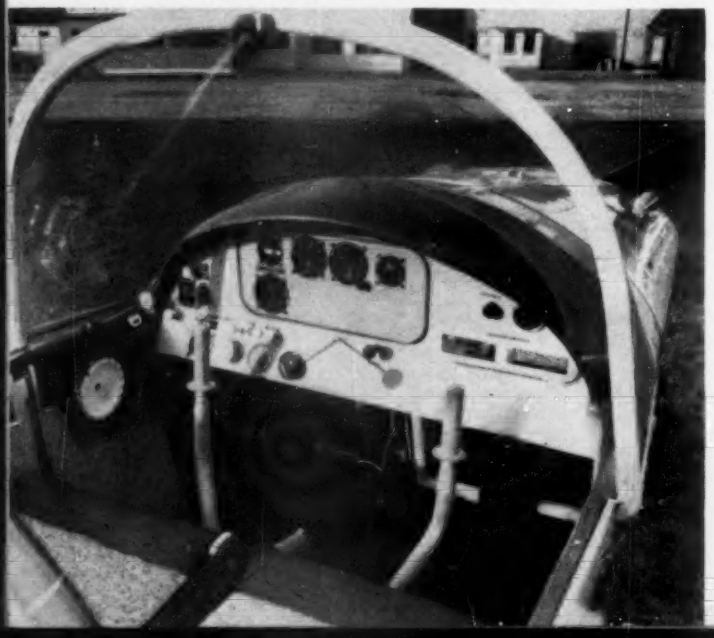
Cockpit space has been extended by a few inches in both width and length, and is extraordinarily generous in so small an aeroplane. There is probably as much or more room than in nearly all American four-seaters, although you must duck slightly to clear the canopy frame when closing the lid.

Apart from a small shelf behind the rear seat, there is no separate baggage space. As a three-seater, ample room is available for suitcases and parcels behind one of the front seats.

These have open-type backs of woven plastic, and are light, cheap and surprisingly comfortable, but the remaining seat and cabin upholstery is of woven cloth, and of quite good quality. Although licensed as a three-seater, the 100-b.h.p. Rallye-Club is cleared for a rear-seat load of 242 lb., which is enough for two small adults or one big one and a lot of luggage. In its clever utilization of space, the Rallye is rather like our own Mini-Minor motor-car, and its handling agility and performance on low power provide a further parallel.

In a spirited half-hour or so at Southampton, accompanied by a non-flying passenger, I found that the Rallye could be placed wherever you wanted it with a flick of the stick, and brought in hanging on its slots and propeller at 50 m.p.h. to be plunked down and stopped in a few yards. Nat Somers invariably motors it in to within a few yards of the control building at Southampton, and touches down on a small piece of tarmac in front. On the rough grass at the edge of the airfield, the soft and effective oleos smoothed out the ride to a remarkable degree, and the tight turns made possible by the castoring nosewheel and potent brakes, compensated somewhat for the absence of nosewheel steering.

Far better than a stall warning indicator, the full-span leading-edge slats eased out like clutching hands whenever the speed was allowed to fall off, or turns tightened up beyond fairly shallow angles, and it was difficult at any time to achieve a recognizable stall. Without flap, and with power off, the stick could be brought back to its aft stop without a breakaway,



Cockpit layout of the Rallye-Club is neat and comfortable, with grouping of nearly all instruments and controls on the port side, although dual throttle plungers are fitted.

the Rallye parachuting down nose-high at about 50 m.p.h. I.A.S. There was a slight right-wing down tendency.

Adding power and dropping full 30° of flap, with very little trim change, enabled the airspeed to be maintained at a similar figure, and the Rallye could be flown in this exaggerated attitude with full controllability. Slight tailplane buffet from flap downwash was evident and, if the stick was pulled hard back, a sort of stall breakaway could be momentarily achieved at about 42 m.p.h. I.A.S.

All that happened, however, was a brief nod in and out of buffet and a slight starboard wing drop. The same characteristics resulted when pulling up into a dynamic stall without flap or power.

Although originally designed for aerobatics, and stressed accordingly, the Rallye as presented in the U.K. has a normal category C. of A. and is restricted from spinning. I suspect that the rudder travel has been slightly reduced to make spinning difficult, if not impossible since, in a sideslip, the Rallye runs out of directional control fairly early. A slipping turn is still a useful supplement to the wide-span slotted flaps for steepening the glide still further, and the Rallye responds well to this sort of treatment.

The air was almost completely calm when I flew G-ARTT at Southampton, and I amused myself by making a hands-off approach from base leg down to the flare-out point for my first landing. The former central trim lever having been replaced by a preferable wheel (now out of reach from the right-hand seat on the port cockpit wall), this was wound fully aft, giving a stable approach speed, with full flap and slats out, of almost exactly 60 m.p.h. The Rallye has a very sensibly graduated A.S.I. among its group of basic non-metric flight instruments, only the engine gauges having exotic calibrations; and the airspeed scarcely varied by a couple of m.p.h. during the hands-off glide.

Slight foot pressure brought the Rallye round the corner from base leg, with the slipstream sighing audibly round the canopy, and only at flare-out height did I touch the stick and hold off with easy aft pressure until we sank smoothly on to the grass at 45 m.p.h. I.A.S. This gives some idea of both the stability and the trim accuracy, the latter being particularly useful in view of an unexpectedly heavy response in longitudinal control. All control circuits in G-ARTT were rather stiff with newness, as evidenced by the noticeable static friction which disguised to a certain extent their true feel.

On take-off, for example, with two up, no flap and almost full fuel indicated on the transparent gauge in the port cockpit wall (moved from starboard in the prototype) for the 110-litre (24-Imp. gal.) wing tanks, I found that fairly heavy pull force was required to unstick with neutral trim. Wound about a third aft, the trim wheel helped an easier take-off at an indicated 55 m.p.h.

Noise buzz at full throttle and 2,700 r.p.m. was less than I anticipated from the large amount of transparency. No more than a little right rudder was required to keep straight and, after a remarkably short run, we droned into the air like a busy bee.

No instructions came with the Rallye when Nat Somers ferried it to Southampton, but the climb felt comfortable at 70 m.p.h. Perhaps a little on the high side for maximum rate, but from rolling to 1,000 ft. in just over 1¼ min. gave quite a reasonable 650 ft./min. or so. The Rallye-Club benefits from the extra 10 b.h.p. compared with the prototype and is unlikely to be produced with the 90 b.h.p. Continental.

The slats stayed out in the climb and retracted slowly after we accelerated to around 90-95 m.p.h. They are completely automatic and have no lock or other control. Their operation is not accompanied by any noticeable change of trim or other apparent effect. Cleaned up, and with 2,400 r.p.m. selected for the cruise, the Rallye settled down to about 105 m.p.h. indicated. This is a little slower than some similarly powered lightplanes, but then the Rallye is a lot of aeroplane for 100 b.h.p. to cope with. Not that it feels underpowered—at least with two up—and the same airframe with the 145-b.h.p. Continental (the Super-Rallye) is a full four-seater.

Probably because of control friction no stick-centring was evident after aileron deflection but, with its marked dihedral and heavily chamfered wing-tips, the Rallye is undoubtedly stable laterally. The ailerons themselves, being long-chord and short-span, have a slightly unusual feel; a firm hand is needed for initial application but, with continued stick deflection, the rate of roll becomes brisk. The Rallye is far less

Although licensed as a three-seater the Rallye-Club can seat four in comfort, as the author and Nat Somers demonstrate. There is a remarkable amount of room for so small an aeroplane.

As Nat Somers banks away from the photographic aircraft, the M.S. 880B Rallye-Club shows off its high-lift wing and revised undercarriage design. The flying photographs on this and the preceding page show the exceptional field of visibility and generally attractive lines of the Rallye.

"nervous" on the controls than most Continental types, and gives an impressive feeling of solidity in the air.

This is contributed to by the firm elevator control, but the longitudinal loads can be quickly and accurately cancelled out by the trim wheel. Changes in longitudinal trim are moderate in any condition.

Lowering flap via the central lever and its small release trigger to either of the extended positions results in an initial nose-up tendency, followed by a compensating pitch down which can be cancelled by aft trim. Flap limit is 75 m.p.h., at which the slats also begin to extend. An overshoot from the approach configuration produces only a mild nose-up tendency, and the area-increasing slotted flaps can be dumped at any time without drastic consequences.

The Rallye really looks after its pilots, in fact, at all times and if, as a trainer, it is ridiculously easy and forgiving to fly, then this is the modern trend (and a thoroughly good thing, too). It certainly seems robust enough to stand up to the wear and tear of instructional flying, and combines its design sophistication with a real rough field capability. Its limiting dive speed of 153 m.p.h. is unlikely to be exceeded by the most determined student and with its hefty elevator control gradient, it should stay without difficulty within its 3.8 *g* manœuvre limit.

Except for the grouping of nearly all controls and selectors on the port side of the instrument panel, the cockpit layout conforms to generally accepted standards, and the dual throttle plungers are a useful addition for training. The Rallye has an electric fuel pump for starting, take-off and landing, and a "generator energization cut-off" switch (as well as a master switch) but no warning light.

Ample space is left on the panel for a full set of flight instruments and a small VHF set or two. The dual control does not include duplicated toe brakes, but those on the port rudder pedals, which are of the pendulum type, incorporate individual parking catches.

I like the Rallye, which is a willing and able little aeroplane representing unprecedented value. Production is still in the process of acceleration, so that deliveries are likely to take a few months, but the Rallye is well worth waiting for in the field of the small light aeroplane. From a personal preference, I would like to see the added luxury of nosewheel steering introduced, and perhaps a slab or all-moving tailplane as a refinement to longitudinal control, but in the absence of these I'll take the Rallye as it is—any time and any place.

LEADING PARTICULARS

Dimensions.—Span, 31 ft. 6in.; length, 22 ft. 9 in.; height, 8 ft. 6 in.; wing area, 132 sq. ft.; track, 6 ft. 10½ in.

Weights.—Empty, 1,000 lb.; full fuel (24 Imp. gal.), 173 lb.; three occupants, 480 lb.; available for equipment and baggage, 45 lb.; max. gross, 1,698 lb.

Performance.—Max. speed, 125 m.p.h.; cruising speed, 110 m.p.h.; initial climb, 590 ft./min.; service ceiling, 11,300 ft.; take-off run, 590 ft.; landing run, 295 ft.; range, 500 miles.

Gliding Notes

by Dr. A. E. Slater

FROM Norway Mr. R. C. Abrahamsen writes of national height records and other high flights made in waves during the autumn, in the neighbourhood of Trondheim. On Sept. 29 Jon Trengereid, of the Technical University Flying Club, reached an absolute altitude of 22,000 ft. with a height gain of 18,000 ft. over Selbu, 25 miles S.E. of Trondheim. This would be about 25 miles N.W. of the centre-line of the mountain range dividing Norway from Sweden.

On the same day Ola Raaness, of Trondheim Flying Club, reached 14,000 ft., gaining 11,000 ft., but could go no higher, not having oxygen. The sailplanes used by these two were an L-Spatz-55 and a Lo-100.

The weather map shows Trondheim to have been in the warm sector of a depression this day until the cold front came through at about 18.00 hrs. But the surface wind was from the south.

Another good day was Nov. 8, for which the chart shows a warm front approaching; when it passed over at about 17.00 hrs., a concentration of isobars gave a wind of force 7 from the S.S.E. Ole A. Heinz, of the Technical University Club, gained 12,500 ft. and completed his Silver "C" by flying 40 miles from Bratsberg to Rinleiret.

Waves giving such results, Mr. Abrahamsen writes, "only appear in connection with extreme turbulence below 3,000-4,000 ft., and are strictly reserved for pilots with great experience," though more moderate waves are also available at times for the less skilled.

It is noteworthy that similar turbulence was encountered by Wolf Hirth in the first lee wave ever to be soared in—the "Moazagotl" wave to the lee of the Silesian Giant Mountains. This was on March 3, 1933, and Hirth described it as "the most exciting towed launch of my life. . . . The aeroplane before me danced like a horse gone wild."

It was not until glider pilots showed the nature of wave motion set up by mountain ranges that meteorologists realized that the rare "mother of pearl clouds" seen chiefly from Norway are formed in waves set up by the big mountain range and propagated up through the stratosphere. Such clouds are at an average height of 23 km. (about 14 miles or 75,000 ft.).

They shine in sunlight when the earth below is in darkness, which can happen for longer periods in Norway than in most other countries and where they are less often seen. The reason for the bands of colour parallel to their edges is that, being wave clouds, they are constantly forming at the windward edge. Thus all the cloud droplets at one particular distance from the edge are the same size.

Mr. Abrahamsen goes on to say that the Trondheim Club has a Bergfalke for two-seater training, two Grunau Babies, a Polish Mucha 100A and the aforesaid German Lo-100. The University Club owns the record-breaking L-Spatz, and their tug is the 85 h.p. Luscombe Silvaire.

* * *

NEXT Easter, from Friday to Tuesday, April 20-24, the Midland Gliding Club announces, there will be the usual rally and competition under B.G.A. rules, and it is hoped, but not yet confirmed, that this will be recognized as a qualifying contest for helping to decide who may enter for the National Championships. Visiting aircraft are limited to 15. The entrance fee of £3 per aircraft covers winch and bungy launches.

Col. Geoff Benson writes that entry forms can be obtained from him at Marston, Pembridge, Leominster, Hereford.

The club's "Wave Safari" week begins on Jan. 1, organized as usual by Ted Stark of the Army Gliding Association.

Nicholas Goodhart announces that he is back from the sea at last and will be starting a job in London in February.

London Gliding Club holds its annual dinner on Feb. 16 at the Old Sugar Loaf, Dunstable.

* * *

PROF. P. B. S. LISSAMAN and R. H. Belter produced a paper on "A Design Proposal for a Minimum Weight Glider" designed "not for performance but for pleasure." The proposed glider is to be called "Le Minimum" and is to weigh 120 lb. with a span of 34 ft.

* * *

THOUGH John Pringle still remains president of the Cambridge University Gliding Club after becoming a Professor at Oxford, the club needs a new chairman. He is to be Wg. Cdr. J. E. P. Thompson, O.B.E., A.F.C., who commands the University Air Squadron and is already chairman of the Trust which owns the club.

A Slingsby Sky acquired by Simon Redman may soon be available to club members.

The Midland Gliding Club's annual Christmas dinner was, in fact, a tea this year, and held on Saturday, Dec. 16. The London Club's Christmas dance was on the same day, and the Kronfeld Club's Christmas party was held on Dec. 20.

FOLLOWING FATHER.—On his 14th birthday, Billy Nelson, of Tehachapi, California, flew three solo glider flights. His father, a captain in the U.S.A.F., is seen congratulating him.

Commercial Aviation Affairs

CONVAIR CERTIFICATE.—Final approval of the Convair 990 was given by the F.A.A. on December 18 after completion of the functioning and reliability phase of certification trials. American Airlines expects to have the 990 in service in January. Deliveries to Swissair are scheduled for the end of this month.

BOEING ORDER.—Lufthansa has ordered two Boeing 707-330Bs for delivery, one in 1963 and one in 1964. These aircraft are of the -320B series with JT3D-3 turbofans and increased range. They will be added to the Lufthansa fleet of five Conway-engined 707-430s, and three 720Bs. Also on order are four 720Bs and 12 727s.

TREK CONSTELLATIONS. — Two S.A.A. Constellations have been leased by Trek Airways and were introduced on services to Europe on Dec. 1. The Trek DC-4 is now used for a very low fare through service to Europe at a return fare of £149 10s. The more leisurely Constellation services take three days and cost £189 10s. return.

AIRLINE PORTER.—Wien Alaska Airlines has purchased a Pilatus Porter for use on bush operations. The single-engined Porter carries seven passengers.

T.A.P. CARAVELLES?—An order for three Caravelles may be placed by T.A.P. in the near future. As reported elsewhere, the merged T.A.I./U.A.T. company has taken a 40% interest in the Portuguese airline.

SLUSH HAZARDS.—Following the slush-on-runway tests made by the F.A.A. and NASA at Atlantic City (see our issue of Oct. 19, p. 516) the two agencies held a technical conference in Washington, D.C., on Dec. 19 and 20 so that the results could be discussed. During the tests a Convair 880 and various traction devices were used to measure drag after thousands of tons of crushed ice had been laid down.

APRON SERVICES.—B.E.A.'s application for the right to provide its own apron-handling services at Manchester Airport has been dismissed in a reserved judgment at Manchester Assizes. These services are at present provided by the Manchester Corporation, and B.E.A. had claimed that it could do the work more cheaply and that the Manchester Corporation was losing money in the provision of these services.

IMPERIAL SUSPENDED. — The F.A.A. has suspended the operating licence of Imperial Airlines "until they can demonstrate to us that their operations meet all Federal standards." Imperial has not operated since the crash of one of its Constellations last month (see our previous issue).

AIRLINER BOX-SCORE

	Total airline orders	Delivered to date
A.W. Argosy	10	9
Avro 748	20	1
B.A.C. One-Eleven	16	0
D.H. Trident	24	0
D.H. Comet 4	60	57
H.P. Herald	15	2
Vickers V.C.10/Super V.C.10	52	0
Vickers Vanguard	43	35
Vickers Viscount	418	408
Boeing 707	209	164
Boeing 720	118	83
Boeing 727	117	0
Convair 880	56	46
Convair 990	27	0
Douglas DC-8	172	152
Lockheed Electra	162	140
Canadair Forty-Four	17	8
Sud Caravelle	145	93
Fokker/Fairchild F-27	157	119

CANARY ROUTE.—B.U.A. has now obtained full traffic rights between London and the Canary Islands. Passengers may now book single as well as return flights from London, and traffic can be booked from Las Palmas and Tenerife also. Passengers or freight can also now be carried between London and the Canary Islands on the B.U.A. West African Safari service.

CYPRUS AIRWAYS BAN.—Following the breakdown of negotiations between Cyprus and Lebanon (see our issue for Nov. 30, p. 707), the Civil Aviation authorities in Lebanon have taken a decision to withdraw permission for Cyprus Airways to conduct flights into and out of Beirut as of the end of December.

MALI TO GHANA.—Air Mali has inaugurated scheduled service by Il-14 on the route to Accra. Ghana Airways is at present training two Air Mali stewardesses.

SYRIAN-IRAQI AGREEMENT.—An agreement between Syrian Arab Airways and Iraqi Airways was signed on Nov. 25, and S.A.A. hopes to inaugurate Damascus-Baghdad services early in January.

C.S.A. TO BEIRUT.—On Dec. 1, the Czech airline C.S.A. inaugurated a weekly Prague-Beirut service, using Tu-104s.

IRISH TRAFFIC.—In October, Aer Lingus carried 51,650 passengers on its European services, 14% more than in October, 1960. The overall load factor was 61%. Traffic on the Dublin-London route fell slightly because of increased B.E.A. participation, but a 77% load factor was achieved. Other route load factors were: Cork-London, 66%, Cork-Bristol, 69%, and Cork-Cardiff, 63%.

FREIGHT RECORD.—American Airlines freight traffic in October totalled 13,237,000 ton-miles, a record for one month by any airline. In the 10 months of this year the airline has flown 103,000,000 ton-miles of air freight.

M.E.A. TRAFFIC.—In the first nine months of this year Middle East Airlines recorded a 37% increase in traffic. Most spectacular statistic was the 245% increase on the London-Beirut service, on which the company carried about 65% of the total traffic.

ANSETT SHARE.—During the 12 months ended June 30, 1961, Ansett-A.N.A. was responsible for nearly 48% of the total Australian domestic passenger ton-miles.

ITALIAN TRAFFIC.—Rome's airports, Fiumicino and Ciampino, handled 6,650 aircraft movements in October—or 47.9% of the total traffic in Italy. Milan handled 2,925 movements or 21.1% of the total. Rome handled 53.3% of the total number of passengers at Italy's airports.

TORONTO SERVICE.—Two more U.S. airlines, Eastern and Mohawk, have been licensed by the C.A.B. to serve Toronto. Eastern will be allowed direct services from points in the eastern U.S. and Florida. Mohawk will provide local service in the Buffalo-Toronto area. The licences are likely to be opposed by Canada.

TEXAS-LONDON SERVICE?—Pan American and Braniff are seeking C.A.B. approval to operate a one-aircraft through service between Texas and Europe. A Pan American Boeing 707 would operate the sectors from European points to Chicago, where it would be taken on as a Braniff flight by Braniff crews to Houston and Dallas.

STAR BUS STARTS.—National Airlines' new Star Bus service has been approved by the C.A.B. National will operate 87-seat DC-7Bs at night-coach fares and no telephone bookings will be accepted, ticket purchases only being allowed.

JAPAN PLAN.—Japan Air Lines has announced its intention to establish a service between Tokyo and London by way of the U.S. West Coast and New York. A starting date is not fixed.

CHEAPER TWIN.—To be unveiled by dealers on Feb. 3, the Cessna 310G will be offered to Americans at a new low price of $59,950. One of three new twins which Cessna is producing in 1962, it has an increased gross weight (4,990 lb.), a 175-lb. increase in payload and improved landing gear. New "stabili-tip" wings carry tip tanks at a 35° angle to obtain dihedral effect.

VESPA JET.—A new impression of the Piaggio-Douglas PD-808 executive transport, now named the Vespa Jet.

LUFTHANSA IN AFRICA.—Inauguration of Lufthansa's new route to Khartoum, Nairobi, Salisbury and Johannesburg (see our issue of Dec. 14, p. 769) is scheduled for the middle of May or earlier. This is part of a larger plan to develop an African network, including a route to Lagos and Accra, starting in March. Boeing 720Bs will be used.

M.E.A.-P.A.A. LINK.—A general sales agency agreement has been concluded between Middle East Airlines and Pan American. Each carrier will represent the other in certain specific areas, starting next month.

IFALPA CONFERENCE.—The 17th annual conference of the International Federation of Air Line Pilots Associations will be held in Stockholm between March 27 and April 3, 1962. The hosts will be the Swedish Pilots' Association.

DJAKARTA SERVICE. — Aeroflot plans to use Il-18s for its weekly service between Moscow and Djakarta, which is to start on Jan. 1, 1962.

T.W.A. INTEREST.—Trans World Airlines has paid out $3,123,611 in interest on its $100 million of 6% subordinated income debentures due on June 1, 1978.

MANCHESTER CARGO.—B.O.A.C. has moved its Manchester cargo section from the city to Ringway Airport. The Corporation's twice-weekly North Atlantic DC-7F all-cargo service operates through Manchester.

DELTA BORROWS. — Agreements with 23 banks and three insurance companies have been signed by Delta Air Lines to provide $25 million to help to finance the purchase of four Convair 880s and three turbofan-powered DC-8s worth $36 million. The remainder of this sum will be "internally generated" by Delta.

FARES DOWN.—A 15% reduction in air fares on certain routes from Moscow and Leningrad has been announced by Moscow Radio.

FREIGHTING STOPS. — National Airlines has ceased operation of its transcontinental all-freight services, introduced during August between Miami, Los Angeles and San Francisco. The company says there is not enough traffic to justify all-freight flights.

N. AMERICAN HELIPORTS.—There are now 487 established heliports or helipads in the U.S.A., Canada and Puerto Rico—an increase of nearly 50% in the number at the end of 1960.

DUNDEE DOUBT.—Dan-Air Services will suspend its London-Dundee scheduled services on Jan. 9 because of lack of support. The company proposes to reintroduce the service next spring for a final trial period.

YEADON AIRPORT.—Representatives of the Leeds/Bradford Airport Joint Committee last week discussed with Ministry of Aviation officials the question of Government financial aid towards the development of Yeadon Airport.

AIRPORT TO CLOSE.—With the withdrawal from service next spring of DC-3s by Alitalia, Regio Calabria Airport will be closed. Future services to this airport depend on purchase of new aircraft or an extension to the existing airport and laying down of a runway.

SLICK SHIFT.—The base of Slick Airways will be San Francisco International Airport from February, instead of Burbank. The all-cargo airline has leased a 50,000-sq.-ft. facility at San Francisco in preparation for operation of its two Canadair CL-44s, soon to be delivered from Montreal.

T.C.A. ABSTAINS.—The plan of 11 U.S. airlines to penalize "no-show" passengers up to $50 (see our Dec. 14 issue) is not to be followed by Trans-Canada Air Lines because most of its "no-shows" are U.S. passengers supposed to transfer from a U.S. airline. Few Canadians fail to "show."

A.T.L.B. Decisions and Applications

(Scheduled Services Only.)

Licences Approved.

A1174. Silver City Airways. Bournemouth-Guernsey/Jersey. For vehicles and their occupants, plus 15 passengers a day each way for Guernsey and for Jersey, in Bristol 170s (or Dakotas for all-freight flights only). Dec. 1961 to Nov. 1968.

A1232. Silver City Airways. Leeds/Bradford-Guernsey/Jersey. Up to 14 round flights a week by Dakota. May to September, 1962-1964.

A1993. Silver City Airways. Jersey-Guernsey-Bournemouth (opt.)-Cherbourg. For vehicles and their occupants, plus 15 passengers on each sector, by Bristol 170. 1962-1968.

Licence Variations Refused.

A382/3. B.E.A. To introduce tariff between Southampton and Jersey.

A964/1. Channel Airways. To carry supplementary passengers and cargo on Bristol-Jersey services.

Applications.

A2220. Executive Air Transport. Birmingham-Newcastle. Tourist class passengers and cargo, 14 a week by Dakota or equal capacity in Heron or Dove. 1962-1969 (continuation of Air Safaris licence A173).

A2221. Executive Air Transport. Birmingham-Derby (opt.)-Wolverhampton (opt.)-Coventry (opt.)-Bournemouth (opt.)-Bembridge-Sandown. Six a day by Dakota or equal capacity in Heron or Dove 1962-1969 (continuation of Air Safaris licence A177).

A2229. Starways. Leeds/Bradford-London (Heathrow). Tourist class passengers and cargo. Unlimited frequency by Dakota, DC-4 or Viscount. 1962-1968.

A2230. Starways. Newcastle-London (Heathrow). Other details as A2229 above.

A2234. Derby Aviation. Newcastle-Leeds/Bradford-Jersey-Guernsey. Tourist class passengers and freight. Unlimited frequency with Argonaut or Dakota. March-Oct. 1962-1969.

A2262. Airlines (Jersey) Ltd. Bournemouth/Southampton-Dublin/Belfast. Tourist class passengers and freight. Unlimited frequency with Heron, Dakota or Herald. 1962-1969.

News About People

B.O.A.C. IN SOUTH AMERICA.—Mr. Trevor J. Glover is to become B.O.A.C.'s assistant general manager, South America, on the staff of the Corporation's general manager, Western routes, in succession to the late Mr. M. A. Snowball. Formerly ground services manager, Eastern routes, Mr. Glover will take up his duties next month. At the same time, Mr. John R. Combe, formerly manager at Buenos Aires for the River Plate and Chile area, will become executive assistant to the general manager, Western routes, Mr. J. Ross Stainton.

M.O.A. RETIREMENT.—Mr. Roger Pugh, O.B.E., the first manager of London's Heathrow Airport, retired from Ministry of Aviation service on Dec. 13. Before taking over at Heathrow, Mr. Pugh was the first manager of the flying-boat base at Poole and, later, of Hurn Airport. During the past five years he has served as a member of the Ministry's London Airports planning team. Mr. Pugh was awarded the O.B.E. for services in connection with the development of Heathrow.

NIGERIAN APPOINTMENT. — Wg. Cdr. A. T. H. Willis, R.A.F. (Retd.), has joined Nigeria Airways as assistant to the technical adviser, Mr. O. Coker. He was formerly regional sales engineer for Africa with Vickers-Armstrongs (Aircraft).

LUFTHANSA APPOINTMENT. — Mr. Hans Ritter has been appointed assistant manager for Lufthansa in the U.K. and Eire. For the past 2½ years he has been district manager for Iran and Afghanistan.

PROJECTS CHIEF. — Mr. N. E. Rundle has been appointed project engineer by Plannair, Ltd.

B.O.A.C. CHANGES.—Mr. R. H. Trench Thompson has been appointed assistant general manager, Eastern Routes. Mr. H. R. Martin Roundell has been appointed assistant to the managing director, Sir Basil Smallpeice, and will work with Mr. Alan Ponsford.

BELLING-LEE DIRECTORS.—Two new executive directors have been appointed to the board of Belling and Lee, Ltd. Dr. A. C. Robb, formerly technical manager, now becomes technical director and Mr. J. R. Turrill, sales manager, is now the sales director.

ELECTRONICS SALES. — Electro Mechanisms, Ltd., of Slough, has appointed Mr. F. A. Ramage as its technical sales manager. He was formerly sales manager of Technical Ceramics, Ltd. Electro Mechanisms recently concluded an agreement with the American company, Schaevitz Engineering.

Correspondence

Air France and Air Union

IN your issue of Nov. 30 (p. 692) last you were good enough to make some reference to a Press conference which I gave on behalf of our federation.

In the course of this conference I drew a comparison as regards Air France, between those quotas which would have been fixed in Air Union and those which have been effectively achieved by Air France in the course of the latest period for which figures are available.

The figure of 44% achieved by Air France is correct, on the other hand a small material error has slipped in. If Air Union had been effectively brought into being the figure would have been 34% not 39%.

As you will see, this gives still more weight to the argument. It is for this reason that I have taken the opportunity of making this correction.

Paris. R. LAPEYRE,
Federal Secretary.
(Fédération des Travaux Publics et des Transports.)

"Leaning Out" the Mixture

REFERENCE a footnote by the editor to an article in the Correspondence column entitled "'Leaning out' Mixture" in the Oct. 26, 1961, issue of THE AEROPLANE AND ASTRONAUTICS.

I suggest that carburetter air temperature is increased not to prevent loss of power from possible carburetter icing, but to ensure that the fuel is completely vaporized, and remains vaporized in the cylinders when ignition occurs. If the mixture is leaned to a critical ratio, and the induction system temperature is below the standard air temperature (for which the engine was designed, and at which it received its certification) the fuel many not vaporize completely. The result may be rough running, occasional missing or back-firing, possible eventual piston head failure from prolonged low-order detonation, and excessive lead deposits on the spark plugs which may cause the engine to cut out completely when engine r.p.m. is increased in preparation for the landing.

The above is based on experience obtained over many years, on many different aeroplanes. Charles A. Lindbergh explained and demonstrated the above conditions when he taught U.S.A.F. fighter pilots how to increase their combat radius in the south-west Pacific area during World War II. Carburetter temperatures were carefully controlled on the C-47s used on the "Musk Ox" exercise in the Canadian Arctic in 1946. Automatic carburetter air temperature control was later provided on the long series of Polar flights made by B-29s in the late 1940s.

Related to the above is a common and serious error appearing on the pilot's check list under the "Take-off" and "Landing" headings. Almost invariably the instructions specify setting the carburetter heat control to the "off" position. No qualification is made for operations in very cold weather, when carburetter temperatures may read −35° C. Theoretically, it would be safest to set the carburetter heat control so that at full power the carburetter air temperature would read what it normally reads on a standard day at full power. In practice, setting the carburetter temperature just above the icing range is probably sufficient to prevent detonation, excessive magneto drop (another symptom of poor fuel vaporization) and complete engine failure on full power operation.

Wilmington, Delaware. W. P. MAEIRSPERGER,
Lt. Col., U.S.A.F., Ret.
Chief, Aerial Recovery Section,
All American Engineering Co.

Simplified Service

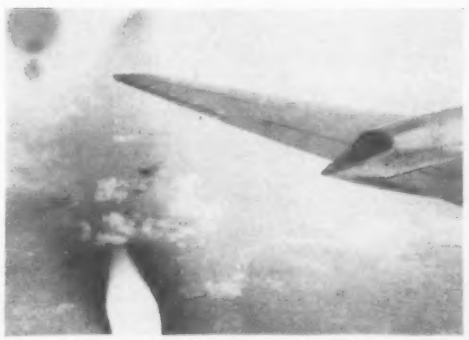
HERE is just one thought for new transport designs—why not make all passengers carry their own bags to the aircraft as is done in the majority of passenger aircraft in the United States?

On my return to London Airport the other night, we disembarked from a Vanguard, picked our baggage out of the hold, carried it up to the Customs, and down the moving staircase and out. No strain on anyone; far quicker, and incidentally, cheaper.

Hemel Hempstead. J. MILLAR.

Wroundabout

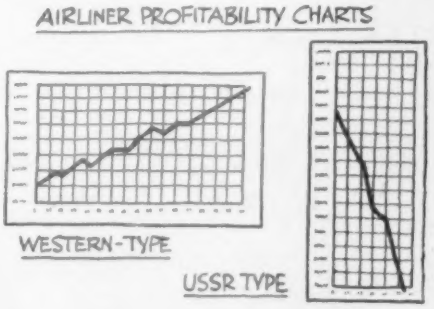
Greetings. This time each year I like to print my thanks to the readers and staff members of this magazine, but for whom, etc. Bless you all—and keep on using old Wren as your aviation humour clearing house. I love it. What happens is that *you* write Wroundabout and the illustrations are just lines which I draw round your lively suggestions. I ease in the occasional photograph when a drawing is beyond my limited talents or when the Editor discards a particularly offensive item which I've submitted on the principle of "Nothing risqué, nothing gained." I *know* he won't accept the suggestive suggestion which has just come in from the Vickers' drawing office, so here's a photograph, taken over Java, to give heart in 1962 to those of you who envy the slick pix which are Lens Wren's speciality. Actually, this picture got me a life membership of the Point, Press and Pray Club. Results as superbly bad as this would be quite beyond our chief photographer Charles Sims and his lads.



1961. A tough year, with the industry's contraction really beginning to show, the situation being tersely summed up by the character who said "That's it—spelt 'M-E-R-G-E-R', pronounced 'MURDER'."

*

Thin Red Line. Somebody in the airliner constructing business tells me that Soviet airline economists who came here during '61 were surprised to learn that it is possible to build *profitable airliners.* I believe they also took back with them some Western-type profitability graphs which differ from their own, it seems, in this way:—



The Russians also learnt that there is not necessarily any connection between profitable airliners and an airline that makes a profit. There's a little old thing called passenger-revenue which seems to get in the way.

by Wren

Industry Record

A Belvedere of No. 66 Squadron sways aloft a light ambulance on the end of a nylon strop (see item below).

Aircraft Equipment from E. E.

In a review of its diverse activities during the past 12 months the English Electric Co., Ltd., makes mention of some of the advances made by its Aircraft Equipment Division. Major orders received include contracts for main generating systems and components for four civil and military aircraft.

Sundstrand constant-speed drives, currently in use on Boeing 707s operated by B.O.A.C., Air India and South African Airways, have now attained an overhaul life of 2,000 hr. These are said to be the only British-built units of their kind in operational use.

The company's contribution to the design and development of aircraft AC generators has been the manufacture of a solid-rotor generator for high-speed flight applications. This is capable of operating at temperatures in excess of 300°C.

Another major advance has been the design and manufacture of control and protection equipment for aircraft main generating systems. With the use of semi-conductors and printed circuits the overall weight of protective circuits has been substantially reduced and at the same time efficiency of the components increased.

Meeting the Demand

A substantial increase of its production resources has been made by Precision Rubbers, Ltd., of Bagworth, Leicester. This has been brought about, says the company, by the increasing demand for the specialized rubber components which it produces for the aircraft industry in particular and also for the electrical and mechanical engineering industries.

An entirely new and enlarged press shop has come into operation at the company's silicone works at Shepshed. Additional facilities at Bagworth include a new engineering department and tool room. At Newbold Verdon, five miles from Bagworth, a new factory is being built for the production of special compounds for the aircraft industry. Production will begin there early in the New Year.

Precision Rubbers' research and development laboratories have also been extended.

Nylon for Helicopter Load Lifting

Strops made from nylon webbing with which a Belvedere helicopter can lift an externally slung load of up to 6,000 lb. are now in use with No. 66 Squadron, R.A.F. —the first to operate the type—after a series of trials.

During these trials it was found that the use of nylon, instead of conventional steel, strops proved most satisfactory on a number of counts. To begin with the aircraft fuselage was subjected to less strain—loads as high as 2*g* had been experienced in the Belvedere using steel strops; the machine handled more easily and lifted more smoothly—with an 8-ft. steel strop the helicopter can be felt to judder at the moment when the load comes on; the use of nylon made ground handling much easier; and as it is a cheaper material production costs are kept down.

Prototype strops in a 2-in.-wide nylon webbing with a breaking strength of 15,000 lb. were made by the G.Q. Parachute Co., Ltd. An 8-ft.-long strop composed of two laminations of this webbing sewn together and with an 8-in. double-thickness loop at each end was found to have a breaking strength of 13.2 tons. This gives a safety factor of rather more than 4.9 on 6,000 lb.

Recordings from a strain gauge link interposed between the aircraft and the hook during flight tests with a 6,000-lb. load showed that no unacceptable loads were put on the aircraft structure even when attempts were made at snatch lifts. Further static tests confirmed that no harmful frequencies were set up anywhere in the range when the strop was excited at 500-lb. load intervals.

At present it is considered that the nylon webbing strop is at an early stage of development and that a number of improvements could be made.

The Federal German Helicopter Establishment at Stuttgart has adapted two Solartron SC. 10 analogue computers as a simple flight simulator with a small model helicopter as an indicator. The control column can be seen in the right foreground. The Establishment has now ordered an SCD. 80 computer from Solartron.

Light Aircraft Flowmeters

New from Meterflow, Ltd., of Feltham, is a range of aircraft flowmeters intended primarily for fitting to the lighter types.

The equipment employs a free impeller-type flowmeter as the sensing element which, in turn, makes use of a unique thrust-relieving device. Completely transistorized, the electronic units are suitable for use from standard 24v. DC supplies and offer either rate of flow or totalized flow information.

"Environmental Engineering"

The Society of Environmental Engineers is to have its own journal to be published quarterly under the above title. The first issue will appear next March. Editing of the journal will be in the hands of Mr. G. Charlish and Mr. D. R. Esson, both members of the Society.

Aviation Calender

1962

Jan. 1

London.—Institute of Transport, Metropolitan Section lecture, "Development of an Airport," by M. G. Housage, at 80 Portland Place, W.1, at 17.30 hrs.

Jan. 4

London.—British Institution of Radio Engineers, Radar Group lecture, "Automatic Techniques in Civil Airline Communications Systems," by W. E. Brunt, at the London School of Hygiene and Tropical Medicine, W.C.1, at 18.30 hrs.

Jan. 5

London.—R.Ae.S. Rotorcraft Section lecture, "Rotating Aerofoils and Flaps," by Dr. S. Neumark, at 4 Hamilton Place, W.1, at 18.00 hrs.

Jan. 9

Luton.—R.Ae.S. Branch lecture, "Agricultural Aviation," by Air Cdre. A. H. Wheeler, in the Napier Senior Staff Canteen, Luton Airport, at 18.00 hrs.

Jan. 10

London.—GAPAN Fourth Livery Dinner, at the Innholders' Hall, College Street, E.C.4, at 19.30 hrs. for 19.45 hrs.

Jan. 11

London Airport.—R.Ae.S. Branch Brains Trust, at B.O.A.C. Headquarters, at 18.00 hrs.

London.—Northampton College of Advanced Technology lecture, "Vickers Aircraft," by H. H. Gardner, at St. John Street, E.C.1, at 13.30 hrs.

Jan. 15

London.—R.Ae.S. Historical Group lecture, "R.101 and Other Airships," by Wg. Cdr. T. R. Cave-Brown-Cave, at 4 Hamilton Place, W.1, at 18.00 hrs.

Jan. 16

London.—R.Ae.S. Astronautics and Guided Flight Section lecture, "Development of Seaslug," by C. Bayly and A. Lightbody, at 4 Hamilton Place, W.1, at 18.00 hrs.

Company Notices

NEW COMPANIES

Executive Handling Services, Ltd. (709,805).—Private co. Reg. Dec. 5. Cap. £500 in £1 shs. To provide services to aircraft operators and air traffic arriving at and departing from airports in Great Britain and to render services and assistance to passengers in such aircraft. Directors: Arthur C. Bryan and Elise D. Bryan, both of 109 Gossops Drive, Gossops Green, Crawley, Sussex. Sols.: Crisp, Harries, Hall and Co., W.C.2. Reg. off.: Imperial Buildings, Victoria Road, Horley, Surrey.

Lowes Hirers (Kinver), Ltd. (709,939).—Private co. Reg. Dec. 7. Cap. £100 in £1 shs. To carry on the business of dealers in motorcars and aircraft. Directors: Charles H. Lowe, Medina, Meddins Lane, Kinver; Arthur C. Lowe, Stone Lane, Kinver, Staffs. Sec.: A. C. Lowe. Reg. off.: Stone Lane, Kinver, Staffs.

Skytaxi, Ltd. (710,155).—Private co. Reg. Dec. 8. Cap. £100 in £1 shs. To carry on the business of air transport contractors. Directors: Michael J. Warner and Mrs. Zena Warner, both of Church Road, Lowfield Heath, Crawley, Sussex. Sec.: M. J. Warner. Reg. off.: Church Road, Lowfield Heath, Crawley, Sussex.

CHANGE OF NAME

Bahamas Helicopters (U.K.), Ltd. (547,907). 380 Gresham House, Old Broad Street, E.C.2.—Name changed to World Wide Helicopters (U.K.), Ltd., on Sept. 27, 1961.

Personal Notices

BIRTHS

Ashworth.—On Dec. 3, at Battle Hospital, Reading, to Kathleen (*née* Baker), wife of Wg. Cdr. A. Ashworth—a son.

Heeks.—On Dec. 7, at Cuckfield Hospital, to Fay (*née* Williams), wife of Flt. Lt. R. Heeks—a son.

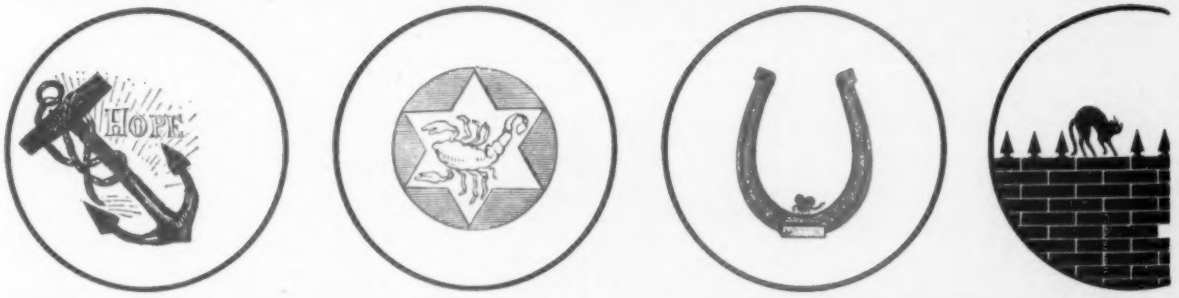
Little.—On Dec. 6, at R.A.F. Hospital, Changi, to Ann (*née* Haworth), wife of Flt. Lt. W. R. Little—a son.

Nelson.—On Dec. 1, at R.A.F. Hospital, Cosford, to Jean, wife of Flt. Lt. T. G. Nelson—a son.

Oliver.—On Dec. 12, at Rodney House, Walton-on-Thames, to Paddy, wife of Wg. Cdr. J. F. Oliver—a son.

Scruby.—On Dec. 8, at R.A.F. Hospital, Ely, to Margaret (*née* Swan), wife of Sqn. Ldr. J. M. Scruby—a son.

DO you trust TO LUCK for your GLASS FIBRE mouldings?



Do you trust to luck and try to make glass fibre mouldings yourself—economically? If you do, cost out the rejects, the plant, personnel, space and you'll realise that it's foolish to gamble like this. Lucky for you, Microcell can make all the mouldings you need, expertly, economically and on time. So, stop taking chances and call in the Microcell Moulding representative to-day. **MICROCELL LIMITED, 9 KINGSWAY, LONDON, W.C.2. COVent Garden 1262**

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Autocar. C. of A. 16.3.62. Engine 567 hrs. to go. **£825**
Auster Mk.V. C. of A. 26.4.62. Engine 528 hrs. to go. Starter. **£1,200**
Auster J1N. C. of A. 7.2.62. Engine 1,192 hrs. to go. VHF. **£1,725**
Airlist Trainer. C. of A. June 1964. Nil hour Gipsy Major engine. VHF. **£1,900**
Autocar. C. of A. 9.5.62. G.M.10 engine. 593 hrs. to go. VHF. Starter. Resprayed and re-upholstered. **£2,195**
Autocar. C. of A. 26.1.63 G.M.10 engine, 600 hrs. to go. VHF. Starter. **£2,900**
Tiger Moth. C. of A. 15.2.62. Engine 300 hrs. to go. **£545**
Tiger Moth. C. of A. 1.10.62. Engine 627 hrs. to go. **£650**
Magister. C. of A. 18.4.63. Engine 810 hrs. to go. **£695**
Procter V. C. of A. 1 year. Engine 527 hrs. to go. L.B. tanks. VHF. **£550**

EXECUTIVE AIRCRAFT DIVISION

Bonanza. C. of A. 28.3.64. Engine 730 hrs. to go. VHF. VOR. ADF. **£5,250.**
Travel Air. C. of A. July 1962. Engines 720 hrs. to go. HF. VHF. VOR. ADF. **£16,000.**
Cessna Skylark 1960. C. of A. 3 years. 445 hrs. since new. VHF/VOR. **£4,650**
Cessna 310B. C. of A. March 1962. Engines 600 hrs. to go. VHF (2). ADF. **£10,250**
Dove 1B. C. of A. 8 seats. VHF. ADF. HF/MF. **£7,500**
Dove Series 5. Zero hour engines and propellers. New Check 5 o.h. by de Havillands, new executive interior, as as new aircraft for only **£22,500**
Tri-Pacer 1956. C. of A. 26.10.62. 710 hrs. since new. VHF/VOR. **£2,550**
Tri-Pacer 1960 Autofite. C. of A. June 1964. 160 hrs. since new. VHF. ADF. **£4,975**
Apache 1960 model. 470 hrs. total time. Full radio. **£10,750**
Apache 1959 model. 650 hrs. total time. De-icing. Class 1 radio. **£10,000**
Aztec 1960 model. 250 hrs. total time. Airline radio. **£22,000**

TRANSPORT AIRCRAFT DIVISION

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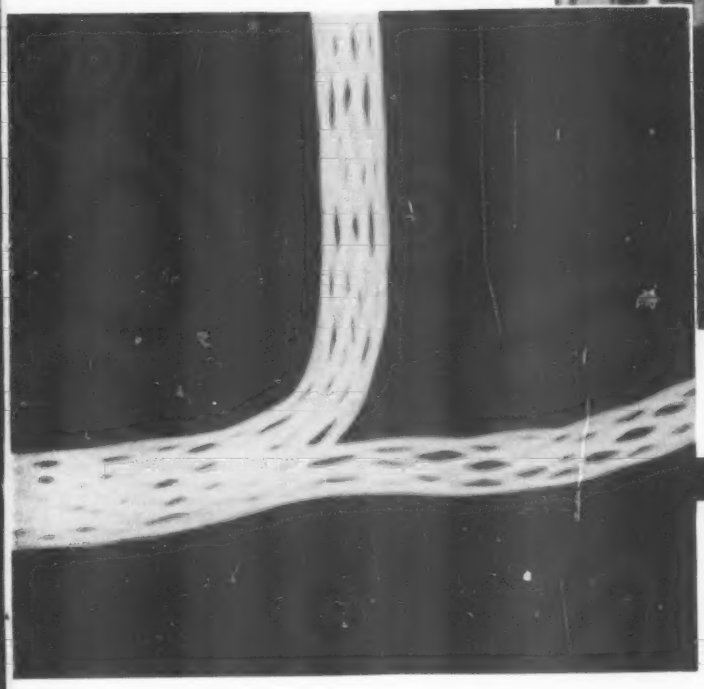

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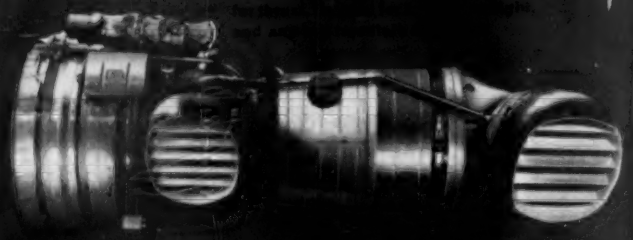

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